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HOWARD JAMES BANKER (1866–1940)

JOHN HENDLEY BARNHART

(WITH PORTRAIT)

Howard J. Banker was born at Schaghticoke, Rensselaer County, New York, 19 April 1866. He was a son of Amos Bryan Banker and Frances Alcena Welling his wife, and was a descendant in the 7th generation of Laurens Mattyse Bancker, an early Dutch settler in the colony of New York.

After his graduation from Syracuse University in 1892, he taught for three years at the Troy Conference Academy, at Poultney, Vermont. While here he prepared himself for the Methodist ministry. It was during this period that he married, 23 August 1894, Mary Eugenia Wright, who was his companion for the remainder of his life (46 years).

He served in only one pastorate, Union Church at Proctor, Vermont, from 1895 to 1898; then he entered upon graduate work at Columbia University, receiving the degree of A.M. in 1901. It was while at Columbia that he commenced the studies of Hydnaceae with which his name is usually associated in the minds of mycologists. The following year he was a teacher at Dickinson Seminary; his department was mathematics, but his first mycological paper was published in 1901, and was dated at Dickinson. After three years as teacher of biology at the Southwestern State Normal School at California, Pennsylvania, he spent ten years, 1904 to 1914, as professor of biology at DePauw University. In 1906 he received the degree of Ph.D. from Columbia.

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The years 1901 to 1914, about one fourth of his mature life, covered nearly all of his active work in botany. Of his 18 botanical papers, all in the field of mycology, 16 appeared during this period; the longest was "A contribution to a revision of the North American Hydnaceae" (1906), constituting the second number of the 12th volume of the Memoirs of the Torrey Botanical Club. This discussed 62 pileate species distributed in ten genera. He was one of the associate editors of Mycologia from its establishment in 1909 until it became the organ of the new Mycological Society of America in 1933, and to its pages he contributed several papers, including a series of seven under the general title "Type species in the Hydnaceae" (1912–14). This series was based upon the examination of specimens in various European herbaria, including those of Kew, the British Museum (Natural History), Paris, Berlin, Upsala, and Leiden, during the summer of 1910. At his request, Mrs. Banker is presenting his herbarium to the New York Botanical Garden.

In 1914 he joined the staff of the Eugenics Record Office of the Station for Experimental Evolution maintained by the Carnegie Institution of Washington at Cold Spring Harbor, Long Island, and here he remained until his retirement in 1933. His work was chiefly in the field of human genetics, and this fitted very nicely into his lifelong interest in genealogy. He had published a Bancker genealogy in 1909, and in 1913 had completed and edited the Underwood genealogy that was left in manuscript by his botanical preceptor and honored friend, Professor L. M. Underwood of Columbia University. Few genealogists have ever attempted to record causes of deaths, and fewer still have systematically enumerated physical traits such as height, weight, hair-color, and eye-color, or mental traits such as temperament, memory, and talent; yet they have usually told enough about the members of a family to provide a light framework for genetic studies and to suggest promising fields for further investigation. Banker's later studies in genealogy were primarily in the field of aristogenic human heredity.

As an undergraduate he became a member of the Delta Upsilon fraternity, and later (1902) was elected to the honorary fraternity Phi Beta Kappa. He joined the Torrey Botanical Club in 1900,

and was an original member of the reorganized and expanded Botanical Society of America in 1909, but he eventually resigned from both, the latter in 1927, the former in 1933. He became a member of the American Association for the Advancement of Science in 1902, a fellow in 1905, and a life fellow in 1923. While at DePauw he was affiliated with the Indiana Academy of Science.

He died at his home in Huntington, New York, 13 November 1940. The accompanying portrait shows him as he was during his professorship at DePauw University, which was also the period of his greatest botanical activity; he was then about 40 or 45 years old. Another excellent portrait, dating from the same period, forms the frontispiece of his Bancker genealogy, already mentioned.

His scholarship is manifest in his published work. His personality was of an unusually pleasing type. His modesty was almost excessive. His friendships were firm and enduring. The passing of such a man leaves wounds that only time can heal.

His published botanical papers were as follows:

A preliminary contribution to a knowledge of the Hydnaceae. Bull. Torrey Club **28**: 199–222. 18 Ap. 1901.

A historical review of the proposed genera of the Hydnaceae. Bull. Torrey Club **29**: 436–448. 25 Jl. 1902.

Observations on *Phallus Ravenelii*. Torreya **4**: 5–8. 27 Ja. 1904.

Notes on the variability of *Hypothele repanda*. Torreya **4**: 113–117. 27 Au. 1904.

A contribution to a revision of the North American Hydnaceae. Mem. Torrey Club **12**: 99–194. 13 Je. 1906.

A new fungus of the swamp cedar. Bull. Torrey Club **36**: 341–343. *pl. 24*. 17 Je. 1909.

A correction in nomenclature. Mycologia **2**: 7–11. 1 Ja. 1910.

Steccherinum septentrionale (Fr.) Banker in Indiana. Proc. Ind. Acad. **1910**: 213–218. *illust*. 1911.

Type studies in the Hydnaceae—I. The genus *Manina*. Mycologia **4**: 271–278. 28 Au. 1912; —II. The genus *Steccherinum*. Mycologia **4**: 309–318. 23 N. 1912; —III. The genus *Sarcodon*. Mycologia **5**: 12–17. 13 Ja. 1913; —IV. The genus *Phellodon*. Mycologia **5**: 62–66. 10 Mr. 1913; —V. The genus *Hydnellum*. Mycologia **5**: 194–205. 10 Jl. 1913; —VI. The genera *Creolophus, Echinodontium, Gloiodon,* and *Hydnodon*. Mycologia **5**: 293–298. 25 N. 1913; —VII. The genera *Asterodon* and *Hydnochaete*. Mycologia **6**: 231–234. 26 S. 1914.

An instructive modification of an old experiment. Proc. Ind. Acad. **1912**: 93, 94. *illust*. 1913.

Notes on Florida fungi. Mycologia **19**: 39–42. 1 Ja. 1927.

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A FUNGOUS DISEASE OF CODLING MOTH LARVAE

VERA K. CHARLES

(WITH 1 FIGURE)

In April of the past year specimens of codling moth larvae (*Carpocapsa pomonella* L.) apparently killed by a fungus, were referred to the Division of Mycology and Disease Survey by Dr. W. S. Hough, of the Winchester Research Laboratory, of the Virginia Agricultural Experiment Station. At this time also Mr. Dickinson, entomologist for the Sherwin-Williams Company, reported that about 10 per cent of the larvae in an apple orchard at Berryville, Va., had been stricken with the disease. An inspection of the orchard by the writer two weeks later showed the per cent of larvae attacked to be much higher than originally estimated, possibly 40 per cent of the larvae being killed. Mr. Dickinson's continued observation of the orchard led him to confirm this estimate of the higher per cent of control exerted by the fungus.

Two other occurrences of this fungus on the larvae of codling moths have been observed by the writer, one collection from Vincennes, Indiana, received from Dr. Alvah Peterson in 1927, and a second collection from Delaware submitted by Mr. Floyd S. Zimmerman in 1930. According to Mr. Zimmerman the fungus appeared to be doing effective work in reducing the numbers of overwintering codling moths on the apple trees.

GROSS APPEARANCE

The dead larvae were hard and in many instances covered with white to grayish mycelium which on examination was found to be fruiting, though sparingly. In addition to this type of fructification, slender, brownish clavae (FIG. 1) were present in about 20 per cent of the specimens collected in the Virginia orchard. The clavae consisted of closely packed, parallel hyphae bearing the same type of fruiting bodies as the loose mycelium on the exterior

of the bodies of the dead larvae. The latter were hard and filled with coarse mycelium consisting of numerous short segments.

THE FUNGUS IN CULTURE

The fungus grew readily from the mycelium within the hardened bodies of the larvae and fruited within 10 days but did not produce clavae. However, the latter developed abundantly on the bodies of the dead larvae after being kept at a cool temperature for about 10 days. The organism grew well on cornmeal agar and Thaxter's potato dextrose, but slowly on Molisch's agar. A very active species of *Fusarium* frequently overgrew young cultures, sometimes wholly obliterating them, but it never appeared to be the primary parasite.

IDENTITY OF THE FUNGUS

A comparative study of the fungus on the exterior of the codling moth larvae and of the cultures grown from the mycelium filling the body cavity, showed the two organisms to be identical. In one instance, two immature perithecia were found on a clava, but no other development of an ascogenous stage was observed. Until there is an opportunity to study mature specimens of the perfect stage, the fungus must be referred to the form genus *Hirsutella,* established by Patouillard (**2**) in 1892 for a fungus on a coleopterous insect from Brazil. The genus *Hirsutella* is characterized by slender, erect clavae from which phialides arise. The latter have an inflated base and one or occasionally two long thread-like sterigmata, each bearing a single apical conidium. The conidia are surrounded by a gelatinous substance which causes them to adhere in clusters. Patouillard regarded the fungus as a Basidiomycete and referred it to the Clavariae. In 1912 Speare (**9**) discussed and figured a fungus parasitic on *Perkinsiella saccharicida* in Hawaii which he considered a sterile *Cordyceps.* Later he (**8**) had an opportunity to consult literature and study other material and as a result was able definitely to determine his fungus as a *Hirsutella.* In addition he recognized the true taxonomic position of the genus *Hirsutella* referring it to the Stilbaceae of the Fungi Imperfecti. Petch accepted Speare's allocation of the genus and

in 1932 (**4**) reduced his genus *Trichosterigma* (**3**) to synonymy with *Hirsutella* Pat. At this time Petch stated that no ascigerous stage had been previously recorded for any species of *Hirsutella,* but that during an examination of a collection of Ceylon species of *Cordyceps* he found that *C. unilateralis* had a *Hirsutella* conidial stage, the apex of the clava being at first conidial. Since this date several species of *Hirsutella* have been found to be the conidial stages of species of *Cordyceps.*

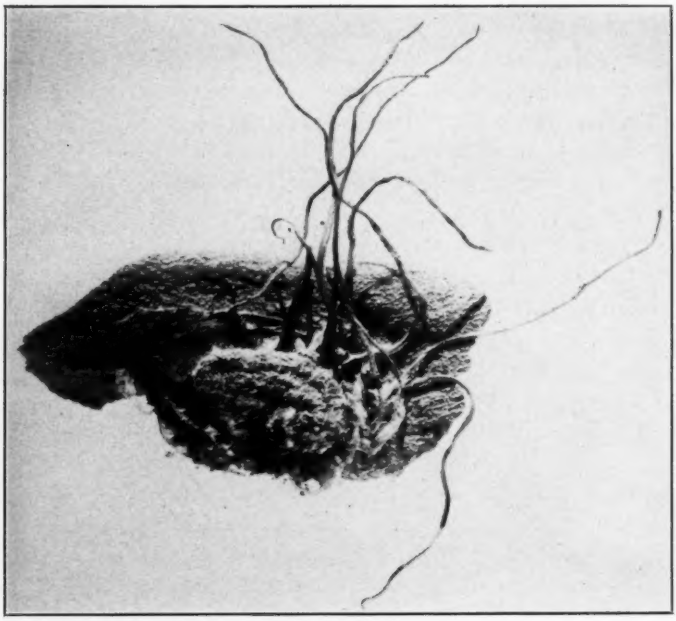

FIG. 1. Codling moth larva showing development of clavae of *Hirsutella subulata* Petch.

In 1932 Petch (**4**) described *H. subulata* on an undetermined caterpillar collected at Milton, Northamptonshire, England, and recorded by Berkeley and Broome as *Isaria floccosa* Fries. This specimen is now in the Kew Herbarium. Some doubt seems to exist as to the common identity of these two fungi, *I. floccosa* Fries and *H. subulata,* but Petch remarked that the combination *H. floc-*

cosa Fries is preoccupied by Speare's use of the binomial (**8**, p. 69), therefore the English species may be named *H. subulata* without considering its possible identity with *Isaria floccosa* Fries. Fries' type specimen was recorded on *Bombyx jacobae* (*Lepidoptera*), cinnabar moth, but the description (**1**, p. 274) is very brief and unsatisfactory. This species may be a *Hirsutella* as Petch inferred, but because of the absence of the type specimen for examination no definite decision can be reached. The uncertainty of this reference is further increased by Fries' statement that *I. floccosa* is related to *I. arachnophila* Ditm., which fungus Petch's investigations have shown to belong to *Hymenostilbe* (**5**), a genus established by him in 1931. A second English record of *I. floccosa* was made in Yorkshire on a dead grub which had crept inside a perforated empty shell of a hazel nut at Masham, 1901. According to Petch (l.c.) this specimen was not available for examination.

In 1937 (**6**) Petch discussed two North American specimens of *H. subulata* from the Farlow Herbarium. One specimen (Farlow Herb. *4*) was on the larva of *Aegeria Pyri* Harris in apple bark, collected by J. L. Zabriskie, Flatbush, Long Island, New York. The fungus was described as having 3 clavae, with the bases of 4 or more others present. These were linear, terete up to 1.5 cm. high and 0.3 mm. in diameter. The measurements of the conidia were given as $4–6 \times 1.5–2\ \mu$, the conidial cluster was oval and about $8 \times 5\ \mu$. The second specimen collected by C. O. Riley at Washington, D. C. (Farlow Herb. *6241*) was recorded as on the larva of a codling moth under a piece of bark.

Until the ascogenous stage of the fungus is known, it would seem best to refer the American species of *Hirsutella* on codling moth larvae to *Hirsutella subulata* Petch, although certain differences are to be noted, such as the occasional bifurcate clavae and 2-sterigmate phialides. The latter character was given in Patouillard's original description of the genus, but Petch first described the basidia or phialides as termed by him as bearing a single sterigma. However, he later referred the conidial stage of *Cordyceps clavulata* to the genus *Hirsutella,* calling it *H. lecanicola* (Jaap) Petch regardless of the fact that Pettit (**7**) described and figured it with simple or branched sterigmata. *Hirsutella nodulosa* Petch is also illustrated as having more than one sterigma, but is de-

scribed by Petch as being abnormal. The author's observation and study of the species of *Hirsutella* on many different insect hosts would indicate that this is not a generic character.

While the measurements of the phialides, sterigmata and conidia in the American form exceed those given for *H. subulata* Petch, the differences would not seem to justify describing a new species, especially since the measurements of the conidia given by Petch for the Farlow specimens (phialides and sterigmata not described) exceed the measurements which he gave in his diagnosis of *H. subulata*.

The following table is given to permit of a direct comparison of the measurements of the English and American specimens. The measurements of the English material are those given in the description of *Hirsutella subulata* Petch (**6**).

COMPARATIVE MEASUREMENTS OF SPECIMENS OF *Hirsutella subulata* PETCH

Source	Phialides	Sterigmata	Conidia
England	4 × 5 μ	5–8 μ	1 × 2.5 μ
Virginia	6–10	8–10	2–2.5 × 5–6
New York (L. I.)	Not given	Not given	1.5–2 × 4–6
Dist. of Col.	Not given	Not given	1.5 × 4

In view of the data here presented, and in the absence of a mature ascogenous stage, the American species of *Hirsutella* on codling moths may be definitely determined as *Hirsutella subulata* Petch.

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STUDIES IN THE GASTEROMYCETES III. THE FAMILY, ARACHNIACEAE

W. H. Long

(with 7 figures)

This paper gives an emended description of the family Arachniaceae, and of the genus, *Arachnion,* describes a new genus and species, *Araneosa columellata,* gives keys to the genera and species now included in the family and discusses briefly *Arachniopsis albicans.*

Arachnion album was originally described by Schweinitz [1] in 1822 from material collected in North Carolina. Other species have since been added, but only *A. album* has been considered in the family and generic descriptions, although some of the foreign species have other characters that should be included. It therefore seems wise to emend the diagnoses so as to include all of the characters now known to belong to this family.

Arachniaceae.

Sporophore epigeous or hypogeous, sessile or stipitate, with or without sterile base; *peridium* single or double, dehiscent or indehiscent; *columella* present or absent; *gleba* of distinct chambers lined by the hymenium, these chambers forming at maturity a mass of minute separate, hollow, peridioles which contain the spores; *capillitium* none; *spores* continuous.

Key to the Genera

Sporocarp sessile, columella absent ..... *Arachnion.*
Sporocarp stipitate, columella present ..... *Araneosa.*

Tentative Key to the Species of Arachnion

1. Sporophore hypogeous 2
1. Sporophore epigeous 3
2. Sporocarp dehiscing by an apical lacerate stoma ..... *A. rufum.*
2. Sporocarp dehiscing irregularly, gleba yellow ..... *A. Drummondii.*
3. Peridium single, without sterile base 4

[1] Schweinitz, L. D. von. Syn. Fung. Carol. 59, *pl. 1, fig. 2.* 1822.

3. Peridium double, with sterile base ..... *A. scleroderma.*
4. Gleba brown ..... *A. bovista.*
4. Gleba gray or ash gray 5
5. Spores apedicellate 6
5. Spores pedicellate, threads of peridioles not coloured ..... *A. tener.*
6. Sporocarp white, small ..... *A. album.*
6. Sporocarp large, dark fuligineous ..... *A. giganteum.*

A discussion of the species of *Arachnion* will appear in a later paper.

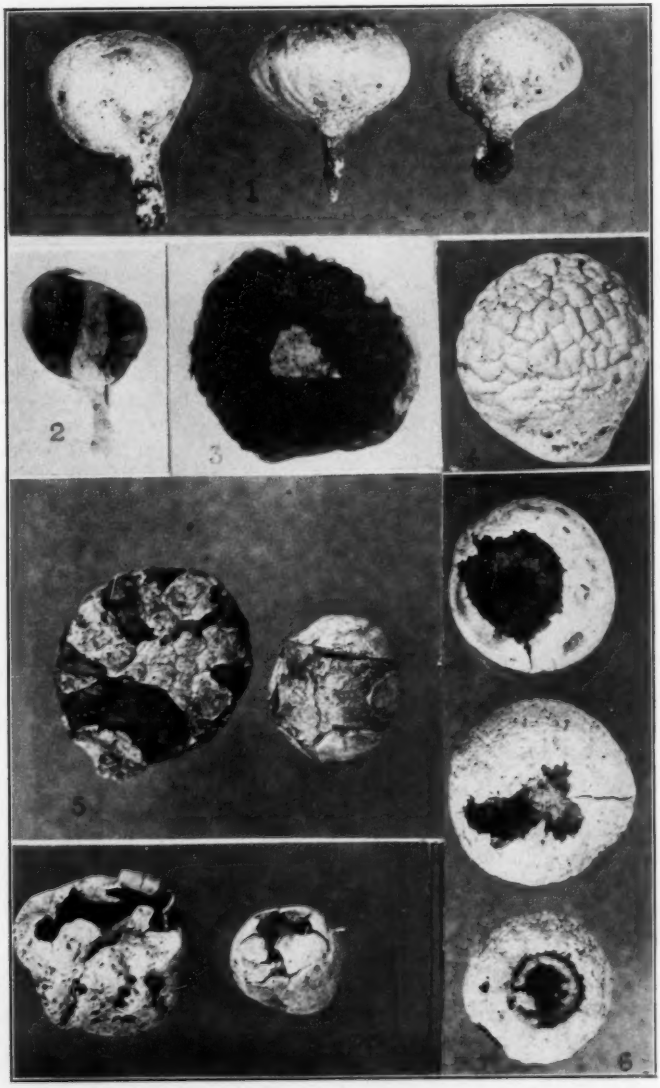
Araneosa gen. nov.

Sporophore epigeous, stipitate, sterile base none; *peridium* of two layers, an exoperidium and an endoperidium; *exoperidium* membranous; *endoperidium* semi-gelatinous to sub-fleshy when young; *dehiscence* by a single, basal orifice; *stipe* central or sub-eccentric (FIG. 1, 2), short, continuing as a columella to apex of the sporocarp (FIG. 2); *columella* prominent (FIG. 3, × section view), persistent, free throughout from gleba; *gleba* a mass of granules or peridioles; *peridioles* irregular in shape and size; *spores* smooth.

Sporophora epigaea, stipitata; *peridium* duplex; *stipes* centralis vel sub-excentricus, ad apicem peridii continuus et *columellam* prominentem, persistentem formans; *gleba* initio cellulosa, maturitate peridiolis numerosis appressis (nec connexis) polysporis praedita, basi sterili destituta; *capillitium* nullum.

Araneosa columellata sp. nov.

Sporocarp subglobose to depressed-globose (FIG. 1), 2–3.5 cm. in diameter by 1–2.5 cm. high, occasionally with a partial partition in the gleba but not sufficient to divide the spore sac into complete compartments; *exoperidium* white, often becoming light buff with age, rarely tan, smooth or usually strongly rugose (FIG. 4), giving the surface a wart-like appearance, persistent but often flaking away partially under weathering (FIG. 5); *endoperidium* semi-gelatinous when young becoming thin and brittle at maturity, brown to reddish-brown where exposed (FIG. 5), reddish-brown to terra cotta on inner surface next to gleba; *stoma* a basal orifice left by the caducous stipe (FIG. 6), becoming large and lacerate by cracks radiating from it, which often cause the entire sporocarp to split into spreading segments; *stipe* solid, 7–10 mm. high by 2–7 mm. thick, usually enlarged at the top, soft, spongy, very loosely attached at maturity to base of sporé sac by a delicate, yellowish, arachnoid membrane which easily ruptures, thereby



FIGS. 1–6, *Araneosa columellata*, × 1; 7, *Arachniopsis albicans*, × 1⅔.

freeing the stipe so that winds and rains readily separate it from the sporocarp; so loosely are the stipes attached that over 50 per cent of the specimens when collected had lost their stipes and were just little balls rolling around on the ground, even in the herbarium the stipes separate easily from the spore sacs unless very carefully handled; *columella* arachnoid to cottony in texture, having a delicate, very loose, hyaline tissue of thin, flaccid, branching hyphae of varying thickness, traversed lengthwise by yellowish, solid, terete, very long, non-septate, sparingly branched hyphae, 3–7 microns in diameter, firmly attached to the inner wall of the endoperidium at apex, light yellow to pale tan, 5–7 mm. thick at base where joined to the stipe, terete, often attenuate, flattened and denser toward apex, frequently eccentric in the sporocarp (FIG. 2), lower two-thirds usually deciduous with the stipe leaving a conical cavity through which the peridioles escape; *gleba* yellowish to cream color when young becoming mouse gray to neutral gray at maturity, consisting of peridioles arranged in a somewhat lamellate manner (FIG. 2); *peridioles* subglobose to irregularly oblong to angular, walls rather thick and firm, 90–268 microns by 134–402 microns, held loosely together by delicate interwoven hyphae, easily separable from the endoperidium, leaving its inner surface reticulate, the lamelliform arrangement of the peridioles often permitting the gleba to split into flakes which easily crumble into the individual peridioles; *spores* oval, 4.2–6 by 5.6–7 microns, 1-guttulate, many semi-opaque, pedicellate; *pedicels* 2–4 microns long, subhyaline to hyaline, fragile; *epispore* chestnut brown, smooth.

Sporocarpium subglobosum vel depresso-globosum, 2–3.5 cm. latum, 1–2.5 cm. altum; *exoperidio* albido, rugoso; *endoperidio* tenuissimo, glabro, brunneo, cavitate basali dehiscente; *ore* ex irregulari elliptico; *gleba* flavida demum grisea; *peridiolis* friabilibus, irregulariter globosis vel angulosis; *sporis* brunneo-nigris, ellipticis, levibus, 4–6 × 5–7 micra, uniguttulatis, pedicellatis.

HABITAT: Solitary on the ground in open grassy areas in Mesquite-Catclaw flats (Prosopis-Acacia).

DISTRIBUTION: Arizona, Santa Cruz County, 6–8 miles from Nogales on State Highway 89, elev. 3857 ft., *W. H. Long & Victor O. Sandberg,* Nov. 23, 1933, *10 plants* no. *7935;* Feb. 19, 1934, *7 plants* no. *7945;* Sept. 21, 1934, *175 plants* no. *7937 Type;* Nov. 13, 1936, *18 plants* no. *7941; W. H. Long,* Sept. 30, 1939, *62 plants* no. *8388.* Pima County, 8 miles from Tucson on road to Sabino Canyon, elev. 2400 ft., *W. H. Long & Victor O. Sandberg,* Sept. 22, 1934, *4 plants* no. *7993* & *22 plants* no. *8018; W. H.*

Long, Nov. 10, 1938, *1 plant* no. *8289;* Sept. 29, 1939, *6 plants* no. *8406.* All collections are deposited in the Long Herbarium.

When the sporocarps are soaked in water for several hours the exoperidium can be easily separated from the endoperidium; the former on drying becomes thin and papery, while the endoperidium after the soaking becomes soft and shows its gelatinous to subfleshy nature.

Araneosa columellata probably occurs throughout the region between Nogales and Tucson, a distance of some 65 miles, as well as, beyond the limits now known, under similar soil and climatic conditions. It is usually associated with *Secotium arizonicum* and externally resembles this plant so closely in size, shape and color that only by examining the gleba can the two be distinguished from each other. *Secotium arizonicum* has been found in Mexico south of Nogales and also near Safford, Arizona, which is about 85 miles northeast of Tucson. It is very probable that *Araneosa columellata* also occurs in these regions since the two plants grow under similar environments.

The present characters of Arachniaceae as now emended indicate that this family probably should be merged with the Lycoperdaceae: the cellular structure of the young stages in the gleba is very similar to that of the immature stages of a *Lycoperdon,* the main difference being the retention at maturity of the cell walls in the gleba in the shape of peridioles while in *Lycoperdon* these walls disappear entirely, leaving the gleba at maturity a mass of spores and capillitia; in certain species of *Arachnion* these cell walls of the peridioles almost disappear, leaving the sporeballs nearly naked as in *A. rufum* and in the Brazilian form of *A. album;* in this case the main distinction between the Arachniaceae and the Lycoperdaceae has practically disappeared.

The writer [2] in 1917 published, as new, *Arachniopsis albicans,* a plant very similar, externally, to *Arachnion,* hence the generic name. He also stated in this article that it differed from *Arachnion* in having a true capillitium, a cartilaginous endoperidium and in not having peridioles. *Arachniopsis albicans* has an apical lacerate mouth (FIG. 7, from type material), is hypogeous when young

[2] Long, W. H. Notes on new or rare species of Gasteromycetes. Mycologia **9**: 271–274. 1917.

becoming partially exposed at maturity, and is without a sterile base. No claim was ever made by the writer that this plant belongs to the Arachniaceae. It apparently should be placed in the Lycoperdaceae, but under what tribe can not be stated since nothing is known of its early stages. It is near the genus, *Lycoperdon,* but its hypogeous habitat, cartilaginous endoperidium and irregular lacerate mouth would exclude it from this genus.

ALBUQUERQUE, NEW MEXICO

NOTES ON ENDOCHYTRIUM DU PLESSIS

JOHN S. KARLING

In October 1933, Du Plessis described a new species of *Synchytrium, S. Cotulae,* on *Cotula coronopifolia* from South Africa in which the zoösporangia are delimited within the walls of the resting spore while the latter is still embedded in the host tissues. Because of this characteristic, he proposed a new subgenus, *Endochytrium,* to include this fungus. In January of the same year, however, Sparrow used this generic name for a group of operculate chytrids which inhabit filaments of *Cladophora* and other algae. Both authors accordingly proposed *Endochytrium* within the same year, but Sparrow's paper appeared eight months earlier than Du Plessis' contribution. Under present rules of nomenclature, Sparrow's genus has priority, while Du Plessis' subgenus becomes untenable and should be discarded. To avoid possible confusion in the future, I propose another name, **Endosynchytrium**, for Du Plessis' subgenus.

Endochytrium Sparrow includes at present two well-defined operculate species, *E. operculatum* (de Wildeman) Karling (**1937**) and *E. digitatum* Karling (**1938**). *Entophlyctis* sp., Karling (pro parte, **1931**) and *E. maxima* Dangeard (**1932**) are possibly identical to *E. operculatum* also. *Endochytrium oophilum* Sparrow is a doubtful species. Sparrow found a few ovate operculate sporangia in rotifer eggs which he believed related to a species of *Endochytrium.* However, no rhizoids or evidence of a rhizomycelium were observed in connection with the sporangia. It is not improbable that Sparrow's fungus may relate to *E. operculatum,* since the author (Karling **1937**) has often found this species inhibiting animal material such as cysts of *Diplophysalis stagnalis, D. nitellarum, Vampyrella* sp., and liver fluke ova where the rhizoids may frequently be obscured by the dense cell content. *Endochytrium oophilum,* none the less, still stands as a questionable species.

Entophlyctis pseudodistomum, described by Domjan (**1935**) as a saprophyte in dead filaments of *Zygnema* and *Spirogyra* in Hungary, is obviously a species of *Endochytrium* also. It has the same structure and type of development characteristic of *Endochytrium* species, and its sporangia are operculate, a character which excludes it at once from *Entophlyctis.* Except for the endogenous method of resting spore development, it is very similar to *E. operculatum,* but whether or not the two species are identical is uncertain at present. I am nevertheless transferring Domjan's species to *Endochytrium* and designating it as **E. pseudodistomum** (Domjan) comb. nov.

In this note I am also recording the occurrence of two species, *Olpidium Stigeoclonii* de Wildeman and *Lagenidium pygmaeum* Zopf, which have not been previously reported in America, as far as I am aware. In 1900 de Wildeman reported *O. Stigeoclonii* as a parasite in cells of *Stigeoclonium* sp. in Belgium, and 31 years later he gave a fuller account with illustrations of its development. Unlike other members of *Olpidium,* the protoplast of this species exudes successive droplets or globules of protoplasm from the mouth of a comparatively long exit tube. These globules free themselves very slowly from the mother mass, become amoeboid, and then momentarily develop a posterior flagellum. The flagellum is lost almost at once, and the amoeboid cells then creep away and infect other host cells. Resting spores have not been seen, and besides the early infectious stages and developmental phases of the thallus and sporangium, nothing more is known about *O. Stigeoclonii.* The unusual behavior of the protoplast in sporogenesis, however, leads one to question the validity of this species as a member of *Olpidium.*

I have frequently collected this intracellular parasite in *Stigeoclonium tenue* at Candlewood Lake near New Milford, Connecticut, and have observed many of the stages described by de Wildeman. Lack of time has prevented further study of this fungus and at present I am unable to add anything new on its identity and relationship.

Lagenidium pygmaeum was described by Zopf in 1887 in pollen grains of *Pinus sylvestris, P. austriaca, P. Laricio,* and *P. Pallasiana* in Germany. It was subsequently reported in pollen grains

in Switzerland, Belgium, and Denmark by Maurizio (**1895**), de Wildeman (**1895**), and Petersen (**1909**, **1910**), respectively. Schultz-Danzig (**1923**) later recorded it in *Cosmarium pyramidatum* from Germany. I have collected this species each spring for a number of years in pollen of *P. austriaca* in Van Cortlandt Park, New York City, and succeeded in transferring it to pollen of *P. sylvestris, P. Banksiana, P. densiflora, P. Strobus, P. austriaca* var. *nigra,* and *Abies canadensis.* Numerous attempts have also been made to infect other hosts, such as living and killed cells of *Nitella flexilis, Chara coronata, Cladophora glomerata, Pithophora* sp., *S. crassa, Mougeotia* sp., and *Hydrodictyon reticulatum,* without success. These negative results lead me to question Schultz-Danzig's report on the occurrence of *L. pygmaeum* in *Cosmarium pyramidatum.* He based his claim on the presence of an irregular, lobed, sac-like thallus with an exit tube which is rarely branched and the fact that in the same culture were numerous pollen grains infected with *L. pygmaeum.* It is possible that his fungus may relate to dwarf thalli of *Myzocytium* or another species of *Lagenidium* which parasitize algae.

Zopf's report that the zoöspores of *L. pygmaeum* are 16 to 18 μ long is obviously wrong. I have frequently observed their formation and activity and found them to be approximately $5 \times 8\ \mu$ in size and bean-shaped with a ventral groove. The thallus of this species is strikingly like that of *Olpidium,* and unless zoöspore emergence is observed, it may be easily mistaken for this chytrid. Fischer (**1892**) believed that the intramatrical resting spores of *Rhizophidium pollinis* reported by Cornu (**1872**, p. 121) may possibly relate to *L. pygmaeum* instead of to that rhizidiaceous chytrid.

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NEW SPECIES OF TENNESSEE FUNGI

JOHN DEARNESS

Ever since the unfortunate fire which destroyed the herbarium of The University of Tennessee in January, 1934, Dr. L. R. Hesler and other members of the botanical staff have been making special efforts to rebuild it. The writer has had the opportunity of examining a number of fine collections of micro-fungi which they have made chiefly in the Great Smoky Mountains National Park. Among them are the following which do not seem to be described in the twenty-five volumes of Saccardo's Sylloge Fungorum or other accessible taxonomies. They are placed in the generic order adopted in Clements and Shear's "Genera of Fungi."

PERONOSPORA FICARIAE Tul.

Parasitic on *Trautvetteria carolinensis* (Walt.) Vail. Sevier Co., Great Smoky Mountains National Park; 15 May, 1938. L. R. Hesler, *11400*. A new host-record.

Phyllosticta Iteae sp. nov.

Maculae numerous, scattered, confluence infrequent, pale reddish-brown above, very pale beneath, circular, bounded by a dark, very narrow line, no discoloration beyond the boundary line, 2–4 mm. in diameter. Pycnidia epiphyllous, amphigenous on a few spots, minutely pustulate, darker than the spot, central pore up to 15 μ wide, not numerous, often in a circle, small, 85–125 μ. Conidia hyaline, globose or broadly elliptic, granular, 6–9 $\times$ 4½–6 μ.

On living leaves of *Itea virginica* L.; Rugby, Tenn.; 31 May, 1934. L. R. Hesler, *6201*, (D. *8735*).

Of the six Phyllostictae on related host-genera, this seems nearest *P. Mitellae* Peck.

Phyllosticta Hesleri sp. nov.

Maculae grayish brown arid areas seeming to begin at the tips of the lobes and extending towards the petiole, blighting large

portions, in some cases nearly the whole of the leaf. Pycnidia black, numerous on the upper side, few on the lower side of the leaf, thickly scattered over the whole discolored portion, mostly centrally depressed, 125–270 μ in diameter, stoma a pore or irregular cleft, the floor much thinner than the upper wall. Conidia hyaline, oblong with rounded ends, guttate and granular, continuous, 12–21 $\times$ 3.75–4.8 μ, on short conidiophores 2 μ thick.

Parasitic on living leaves of *Acer saccharum* Marsh; University Campus, Knoxville, Tenn., 19 Aug., 1938; J. O. Andes (L. R. Hesler, *10674*), (D. *8904*).

Now and again among the others a pycnidium may be found with broadly elliptic or subpiriform conidia about 10 $\times$ 7 μ; whether a variant or different species not determined.

Dothiorella Mali Karst. **fructus** var. nov.

Cells 16 to 30 or more in a stroma; conidia 8–12 (15) $\times$ 3. This is near *D. Cydoniae* Oud. which Saccardo says is very near *D. Mali*. (Sacc. Syll. **18**: 289.)

On decaying fruit of apple, at base of Chimneys, Sevier Co., Great Smoky Mountains National Park, altitude 3000 ft., 17 April, 1938. L. R. Hesler and J. P. Porter, *11277*, (D. *8957*).

D. Mali has conidia "6–10 $\times$ 3 μ"; *D. Cydoniae*, "10–12 $\times$ 3.5 μ."

Phlyctaena Tiliae sp. nov.

Maculae scattered, sometimes closely congregated and becoming confluent over considerable area; yellowish drab at first, brown when old, angular when separate, bounded by veinlets, similar on both sides. Pycnidia darker brown than the spots, about equally visible on both sides but stomate on the lower side only, very thin-walled, pale amber-colored, opening widely, 150–245 μ in diameter. Conidia whitish-hyaline in the mass, issuing naturally in conspicuous tongues or thick tendrils, curved, staining renders 1 to 3 septa visible in matured examples, 33–43 $\times$ 1–1.2 μ.

Parasitic on living leaves of *Tilia americana* L.; Cades Cove, Blount Co., Great Smoky Mountains National Park, 2 July, 1934. L. R. Hesler, *7258* and *8193*, (D. *8731*).

Under the hand-lens very similar to *Cylindrosporium irregulare* (Peck) Dearn.

Septoria farfaricola sp. nov.

Maculae very numerous, thickly scattered, circular, a well-marked, small, white central portion, sometimes bordered and surrounded by a larger grayish portion, black rimmed, the rim with a dark purple band about 1 mm. wide; very pale beneath some of which have unbordered white spots. Pycnidia black, numerous in the older spots, one or more nearly always present in the central white portion of the spots, epiphyllous, 50–60 μ in diameter. Conidia hyaline, straight or curved, continuous, eguttulate, 30–42 $\mu \times 1\ \mu$.

On living leaves of *Tussilago Farfara* L., Greenbrier Pinnacle, Sevier Co., Great Smoky Mountains National Park, Tenn.; 7 June, 1934. L. R. Hesler, *7312*, (D. *8762*).

The spots resemble those of *Septoria Farfarae* Passer. but fruitings are different, the conidia being $55 \times 3\ \mu$ and multiseptate.

Septoria Pachysandrae sp. nov.

Maculae scattered, numerous, white, circular, oftener angular, limited by a red line, small, 1–3 mm., similar on both sides.

Pycnidia numerous, mostly epiphyllous but visible below, brown, 60–120 μ, centrally depressed, opening wide. Conidia hyaline, straight or curved, no septa observed, seem to be on short conidiophores, $19–24 \times 0.5–0.7\ \mu$.

Injuriously parasitic on living leaves of *Pachysandra procumbens* Michx.; in Savage's Gardens, Coal Creek, Tenn.; 3 July, 1934. Coll. J. K. Underwood; (Hesler *7342*), (D. *8769*).

The genus- and species-history of this plant leads one to look among its neighbors for parasitic fungi found upon it. *Septoria acerella* Sacc. and *S. Negundinis* Ellis & Dearn. have numerous small white spots but the conidia of the three are different. From some pycnidia of this collection there issues in water a stout thread of very minute spores (microconidia ?) about $2.5–3 \times 0.6\ \mu$.

Leptothyrium parvulum sp. nov.

Maculae none. Pycnidia numerous, very minute, 0.15 mm. evenly scattered over a portion or the whole of the leaf, epiphyllous, very few seen on the lower side, dimidiate, scutate, black, obscurely radiate, margin thin, pale, stoma central, a minute pore. Conidia hyaline, minute, elliptic, about $3 \times 2\ \mu$; conidiophores few, $10–15 \times 1\ \mu$.

On living leaves of *Rhododendron punctatum,* in same collection as *Gloeosporium ferrugineum;* Mt. Pisgah, N. C., 5600 ft.; 16 June, 1935. L. R. Hesler, *8012, 8013,* (D. *8974*).

Leptostromella Bignoniae sp. nov.

Maculae scattered, arid, nearly white, bordered by a distinct, narrow black ridge, surrounded by a dark purple border 1 to 3 mm. wide, the arid portion an irregular circle 1 mm. to 1 cm. in diameter, similar but paler beneath. Pycnidia black, circular, dimidiate, radiate amphigenous, but more numerous above, minute, 48–105 μ in diameter. Conidia hyaline, straight or somewhat curved, 16–28 $\times$ .75–1.1 μ.

Parasitic on living leaves of *Bignonia capreolata* L.; in a garden, Coal Creek, Tenn.; 28 April, 1934. L. R. Hesler, *7259,* (D. *8732*).

Gloeosporium ferrugineum sp. nov.

Spots epiphyllous, ferruginous, circular, 3 to 10 mm. in diameter, dull yellow margin 1–2 mm. wide, scattered, much paler below and lacking the yellow margin. Acervuli epiphyllous only, scattered over the spot, black, on some spots crowded and appearing as a dark irregular streak just inside of the yellow-margin, opening as a small perforation or a slit in the cuticle, the position sometimes marked by a spore-cirrus. Conidia hyaline, if not washed away remaining as a white cone or cirrus over the opening of the acervulus, straight, cylindric, or narrowed towards one end, obtusely pointed at the ends, contents homogeneous, 13–15 (17) $\times$ 2.75–3.1 μ; conidiophores 10–13 $\times$ 2.5 μ.

On living leaves of *Rhododendron punctatum* Andr., Mt. Pisgah, N. C., alt. 5600 ft.; 16 June, 1935. L. R. Hesler, *8012,* (D. *8801*).

In another collection the yellow margin of the spots is very narrow and obscure. In *G. Rhododendri* Briosi & Cavara the spots are irregular and arescent and the conidia 15–20 $\times$ 4–5 μ.

Gloeosporium Ilicis sp. nov.

Typical leaf-spots lacking; distantly scattered, small groups of acervuli, easily seen, resemble spots. Acervuli amphigenous, prominently erumpent, each more or less covered by a colorless, cuticular scale, 3 to 10 in a small, compact group, becoming somewhat confluent, finally forming a dark, circular scab 1 to 2 mm. in diameter and sometimes appearing on the opposite side of the leaf

as a smaller darkened area, 200 to 600 μ. Conidia hyaline, subglobose to elliptic, varying towards quadrate, 4–9 $\times$ 4–5 μ; in youngest sections seeming histogenic, in the older sections of the darkened masses there are distinct conidiophores up to 15 $\times$ 1.5–2.1 μ.

On living leaves and midribs of *Ilex opaca;* Cade's Cove, Blount Co., Great Smoky Mountains National Park, Tenn., 15 June, 1934. L. R. Hesler, *7359,* (D. *8774*).

Gloeosporium papulatum sp. nov.

Maculae thickly scattered, sometimes incompletely confluent through crowding, circular, mostly 2.5–2.75 mm. in diameter, cinnamon buff, narrow, dark gray border, much paler beneath. Acervuli 1–5 small, whitish blisters or papulae rising 30–100 μ, crowded in the center of the spot, usually on a small, slightly darkened area, mostly epiphyllous, circular becoming irregular, 40–300 μ in diameter or length, at first a mucous granular mass.

Conidia hyaline, subglobose, to broadly elliptic or oval, 3–3.4 μ; no conidiophores observed.

On living leaves of *Rubus canadensis* L.; Mt. LeConte, Sevier Co., Great Smoky Mountains National Park, Tenn.; alt. 2800 ft. L. R. Hesler, *7362,* (D. *8775*).

Coryneum Rhododendri Schw. **fusoideum** var. nov.

Coryneum Rhododendri Schw. and *C. triseptatum* Peck on *Rhododendron* are described in Sacc. Syll. **3**: 781. The form under notice has features common to both. The conidia of the former are said to be oval or piriform on short, thick, septate pedicels. Those of the latter are described as oblong-piriform, 15 to 18 μ long, at first hyaline and biseptate and then 3-septate, the end cells hyaline, the others colored on basidia of equal length, easily deciduous. To the latter Peck adds "the most remarkable feature of the spores is the broad, colored central cell sharply contrasted with the two hyaline cells below it and the single one above it." Having studied Peck's type collection I am able to add that the broad, dark-colored cell is 7–8 μ wide, nearly twice as wide as any of the three nearly hyaline cells and that the conidia are borne on branches of dendriform conidiophores in units 31–42 μ long and about half this width. On one leaf a species of *Monochaetia* is also present.

The conidia of the var. are fusoid to oblong-elliptic, on simple or slightly branched 'phores, of four similar brown cells. The acervuli are in somewhat concentric series on large ashy-gray portions of the leaves.

Apparently parasitic on living leaves of *Rhododendron catawbiense* Michx. Roan Mt., Carter Co., Tenn.; alt. 6300 ft. Coll.: A. J. Sharp, 5 May, 1934. (L. R. Hesler, *7321*), (D. *8764*).

CERCOSPORIDIUM DESMANTHI (Ellis & Kellerm.) Earle.

Cercospora condensata var. *Desmanthi* Ellis & Kellerm.

Parasitic on living leaves of *Desmanthus illinoensis*, 3 Sept. 1934. L. R. Hesler *7352*, (D. *8771*).

Petrak transferred this species to *Camptomeris* which is ranked as a synonym or subgenus of *Cercosporidium* in Clements and Shear's "Genera of Fungi."

Cercospora Halesiae sp. nov.

Spots indefinite, no boundary mark, scattered, mottled brown, more distinct above, 1 mm. to 2 cm., mostly subcircular. Fertile hyphae on shallow, brown tubercles, fascicled, 2–8 on a tubercle, bright brown, seldom quite straight, 30–75 × 5 μ, 2–5 septate. Conidia obclavate, pale-brown, attenuate apically, (30) 47–104 × 5, up to 8-septate.

Parasitic on living leaves of *Halesia carolina* L.; Bote Mt., Blount Co., Great Smoky Mountains National Park; 18 Aug., 1937. C. W. Greene (L. R. Hesler *11280*), (D. *8959*).

CLADOSPORIUM EPIPHYLLUM (Pers.) Fries.

Lindau names numerous arboreal hosts of which the fallen or dead leaves are marked by circular spots produced by *Cladosporium epiphyllum* (Rabh. Die Pilze, Abt. 8. I: 804).

This fungus, rather briefly described, may be the cause of circular dark spots on the yellowed and still green leaves of *Robinia pseudo-acacia* collected on Mt. LeConte, Sevier Co., Great Smoky Mountains National Park, Tenn., at alt. 2800 ft.; 5 July, 1934. L. R. Hesler, *7341*.

Briosia Azaleae (Peck) comb. nov.

Syn. *Periconia Azaleae* Peck, Ann. Rep. N. Y. State Mus. **25**: 93. 1873.
Sporocybe Azaleae (Peck) Sacc. Syll. Fung. **4**: 608. 1886.

Synnemata scattered or gregarious, brown throughout, terminating in a capitular subglobose mass of spores, 0.5–2.2 mm. long by 60–100 μ thick. Spores briefly catenulate, progressively maturing, brown, becoming nearly globose, 3–7.5 $\times$ 2.75–4.5 μ.

A Stilbaceous parasite on buds and twig terminals of *Rhododendron* spp.; *Briosia* is *Sporocybe* with catenate sporulation. Alum Cave, Great Smoky Mts. Nat. Park, Nov. 18, 1938, L. R. Hesler and A. J. Sharp, *11883;* common where a mountain stream crosses the road on the way up to Clingman's Dome, August 18, 1939, Dearness *9000*. No. 11883 was compared with Peck's type example. In descriptions the differences are slight between this and *Briosia ampelophaga* Cavara on the wine grape, the type of the genus.

A careful study of this bud-blight of *Azaleae* extending over several seasons was published by W. H. Davis in Phytopathology, June 1938, pp. 517–528, well illustrated.

Respecting Descriptions in Latin.—Space in Mycologia is at a premium. Papers of special interest to readers of this Journal are for lack of space going elsewhere to less interested constituencies. The latinized descriptions might have been offered in this paper but logically a description in Latin should have exactly the same inclusions and exclusions as the copy in a modern language and therefore occupy nearly equal space. Dictionaries of dead languages like Latin do not supply words for concepts non-existent in the ancient days when these languages were spoken. Modern languages grow to meet the needs of modern sciences. I have not yet discovered the address of any user of these pages who cannot read them or have them locally translated to meet his needs. The latinized descriptions may be expected in that great "clearing-house" the Saccardoan SYLLOGE OMNIUM FUNGORUM. I had the authority of the late Dr. Saccardo's successor, before the war-clouds appeared, for making this statement.

LONDON, ONTARIO.

A NEW WESTERN PHOLIOTA

ELIZABETH EATON MORSE

(WITH 7 FIGURES)

A peculiar agaric has been collected infrequently in the Sierra during the last fourteen years. Specimens were submitted to several mycologists for identification, but no generic name was proposed until a specimen was sent to Dr. John Dearness, London, Canada, who pronounced it a *Pholiota*. Following this lead, the writer sent specimens, notes and photos to him for critical study. His description, accompanied by apology for attempting to describe a dried agaric, is copied verbatim.

Pholiota magnivelata sp. nov.

" Cap—whitish to cremeous, nearly plane, usually irregular, margin inrolled, viscid, 7.6 cm. in diameter.

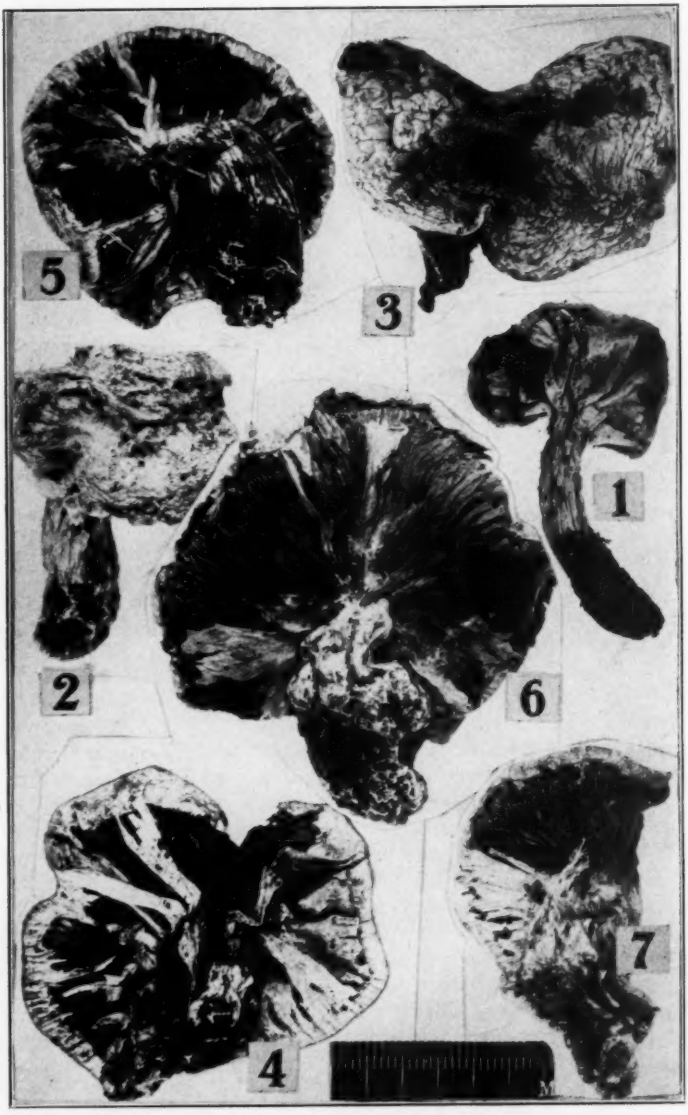
" Flesh—white, rather thin for size of cap, firm, not hard or brittle at first, but becoming hard as it dries.

" Gills—dark rust-color, ventricose, widest near the middle, close, 11 mm. where widest, slightly anastomosed or considerably branched.

" Partial veil—fibrous, a delicate, thin, satiny membrane, fully attached to both margin and stem; at maturity this tissue splits into segments 3–4 cm. long, lower sides partly covered with a white, cottony layer continuous with a similar layer on the stem. *Magnivelata* is a very appropriate term.

" Stem—usually eccentric, concolorous with cap, longitudinally, often deeply ridged, cottony at or near connection with the veil; in cross section a dark brown band one mm. wide under the cuticle, the irregular shrunken tissue inside the band, formerly spongy, shows no evidence of canal or other cavity; sometimes ventricose, sometimes bulbous with base narrowed to quite a sharp point, suggesting growth from decayed buried wood; length 4 cm., longest diameter 1.6 cm., soil-covered on lowest third.

" Spores—the color of the gills, dark-rusty, ocher under microscope, nearly elliptic, some of them flatter on one side, not truncate, some with a short apiculus, smooth under intermediate magnifica-



FIGS. 1–7. *Pholiota magnivelata.*

tion, minutely rough under high power, 7.5–10 × 5–7 μ, average 8.13 × 5.4 μ, wall of visible thickness.

"Cystidia—none observed.

"Taste and odor—not reported; not distinctive in the dried state."

All the collections inhabited damp soil or humus in open coniferous forest in the Sierra or foothills, at 3500 to 6500 feet elevation, as follows:

General Grant National Park, in bank of dry creek bed in partial shade; July, 1927; E. E. Morse. The type collection in liquid is deposited in the University of California Herbarium, No. *638890*.

Same locality, near Administration building; autumn, 1927; H. Bailey.

Same locality, June 21, 1931; Mrs. H. E. Roberts.

Sequoia National Park, Camp Kaweah; July 7, 1936; Mrs. B. B. Nielsen.

Jonesville, Butte Co., altitude 5500 feet; July 27, 1936; E. B. Copeland. "Dried *in situ*."

Jones Creek, above Jonesville, among dead fir needles under snow during winter; August 7, 1938; H. F. Copeland.

Four miles above Camino, Eldorado Co., "among needles of Pseudotsuga and Taxus, in very shaded forest," May 5, 1940; Frank Taylor, comm. H. F. Copeland.

Collections are deposited in the herbarium of the University of California.

The maximum width of cap was 12 cm. The veil which at first covers the expanded hymenium splits into segments as described and finally disappears entirely.

This article is offered in the hope that other localities may be discovered and that additional information or emendations of the description may be reported. Dr. Dearness writes: "For the third time I have gone over my beliefs about this plant. The veil is certainly remarkable for a *Pholiota*. If this species has ever been published the description has escaped getting into the literature accessible to me." (Letter, August 28, 1940.)

I wish to acknowledge my obligation to Drs. Dearness, Seaver, Bonar, E. B. Copeland, H. F. Copeland and Vera Mentzer Miller, and to each of the collectors.

CALIFORNIA MYCOLOGICAL SOCIETY,
UNIVERSITY OF CALIFORNIA,
BERKELEY, FEBRUARY 1, 1941

EXPLANATION OF FIGURES

FIGS. 1–7. Photographs by W. C. Matthews. *Pholiota magnivelata* Dearness: (1) a young sporophore, cap irregular, not fully developed (met obstruction on one side?), margin inrolled, veil a thin, glabrescent membrane firmly attached to both margin and stipe; stipe fairly equal, deeply longitudinally ridged, showing fragments of woolly adhesions, earth stained in lower half; (2) pileus cremeous to ocher colored, glabrous, margin wavy, stipe fairly equal, patches of soil towards the base; (3) one deep sinus, cuticle much wrinkled, viscid, patches of soil and spores still clinging, stipe eccentric, much narrowed at base; (4) under side of pileus showing tendency to split radially, margin much inrolled, veil broken, some of the segments have disappeared; (5) veil less intact, only shreds left; lamellae very close, show some margins with rounded gaps; stipe gradually enlarged towards a soil-stained and rounded base; "the clean white mycelial fibers suggest wood debris or woody humus rather than soil" (J. D.); (6) the largest sporophore collected, older than 4, 5, or 7, lamellae crowded, additional short lamellae extend in from the margin; stipe much shrunken, ventricose at middle, also showing mycelial fibers at base; (7) one large area of veil intact; both 4 and 7 show areas at bases of stipes which suggest possible attachment to rotting wood.

STAGONOSPORA ARENARIA ON GRASSES[1]

RODERICK SPRAGUE

(WITH 2 FIGURES)

INTRODUCTION

Stagonospora arenaria Sacc. causes a blotch disease of aboveground parts of certain grasses in northern Europe and North America. Since the fungus is little known, the following notes on its taxonomy and distribution are presented. The specimens used in this study are as follows:

On: *Arrhenatherum elatius,* State College, Pa., St. John P. Chilton, Aug. 23, 1938; *A. elatius,* Cheshire, England, J. W. Ellis, Oct. 1914; *Dactylis glomerata,* Wallace Bridge, Oreg., R. Sprague, June 23, 1937 (O.S.C. *742*); *D. glomerata,* Hopkinsville, Warren Co., Ohio, W. B. Cooke (*14,531*) Oct. 20, 1939; *D. glomerata,* Foster, Warren Co., Ohio, W. B. Cooke (*14,501*) Oct. 9, 1939; *Elymus glaucus,* Carson, Wash., R. Sprague, Oct. 23, 1937 (O.S.C. *8453*); *E. glaucus,* Tangent, Oreg., R. Sprague, Oct. 15, 1937 (O.S.C. *8487*); *E. glaucus,* Orleans, Linn Co., Oreg., R. Sprague, May 29, 1936 (O.S.C. *10,746*); *E. mollis,* Seward, Alaska, G. F. Gravatt, Aug. 30, 1934 (In Mycological Collections, Bur. Pl. Ind., U. S. Dept. Agr.); *Phalaris arundinacea,* Devil's Lake, Wis., J. J. Davis, Aug. 5, 1913; and *P. arundinacea,* Ames, Iowa, R. Sprague, Sept. 9, 1940.

SYMPTOMATOLOGY

Most of the hosts show characteristic purple or very dark purple-brown lesions. On *Elymus glaucus* and *E. mollis,* the purple spots have light straw or tawny borders. Later the color

[1] Coöperative investigations between the Divisions of Cereal Crops and Diseases and Forage Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, and the Oregon Agricultural Experiment Station. Published as Technical Paper No. 358 of the Oregon Agricultural Experiment Station with the approval of the Director. Contribution from the Department of Botany.

fades as the attacked leaves die, until finally the lesions become virtually indistinguishable from the general straw- or buff-colored dead host tissue. On *Dactylis glomerata* the elliptical lesions, which are dark purple at first, later fade to buff in the center, develop a few pycnidia and finally fade to straw color. On *Arrhenatherum elatius,* collected in the grass plots at State College, Pa., by S. J. P. Chilton, the purple elongate to oval spots have yellow to fawn colored borders. Lesions on *Phalaris arundinacea* first formed purple areas, which faded to discolored or stramineous color. Grove (**3**) claimed that *Stagonospora arenaria* produced no spots on affected hosts. However, he dealt with old material or, as will be pointed out, confused several fungi.

PURE CULTURE STUDIES

An isolation from *Arrhenatherum elatius* made by Chilton developed pale buff mycelia with no yeasty or stromatic tissue present, such as is typical for species of *Septoria* isolated from Gramineae. An isolation from *Elymus glaucus* near Tangent, Oreg., developed buff mycelia virtually identical with that sent by Chilton. Both cultures remained sterile on potato dextrose agar held at 40° F.

No host range studies have as yet been made on this group.

MORPHOLOGY

In the study of the pycnidia and pycnospores, use was made of prepared slides following technique discussed in a recent study on *Septoria* species on Gramineae (**8**).[2]

Pycnidia.—On *Arrhenatherum elatius,* the globose pycnidia have thin walls which are composed of an outer layer of rectangular cells surrounding two layers of somewhat thin-walled cubical cells producing poorly differentiated, blunt bottle-shaped pycnophores, most of which are confined to the basal hemisphere of the pycnidium (FIG. 1, *B*). When spores are mature, the pycnophores are distinguishable, but when the spores are still attached to the wall, the

[2] The assistance of Mrs. Annie Sampson and of the Works Progress Administration under Project 2485 is gratefully acknowledged. Duplicate slides from part of this study are filed in the Mycological Collections, Bureau of Plant Industry, Washington, D. C. The aid of Dr. A. G. Johnson and colleagues in the preparation of this note is gratefully acknowledged.

pycnophores are often scarcely distinguishable from the inner cells of the pycnidium.

On the *Dactylis glomerata,* material from Oregon, the pycnidia are golden brown, obscure, globose, thin-walled and have ill-developed pycnophores. The pycnidia are sunken in the leaf tissue with scarcely erumpent ostioles. The material collected by Cooke in Warren County, Ohio, has golden brown pycnidia, which are semi-mammiform, 90–125 μ diameter, with a slightly browner ring of cells about the ostiole.

On *Elymus glaucus,* all collections show sub-erumpent, light brown strongly flattened elliptical pycnidia 50–80 $\times$ 70–110 μ. The outer walls consist of one to several layers of rectangular thin-walled cells, 3–4 μ thick. Inside this area is an equally thin layer of hyaline, loosely knit rectangular cells, which give rise to blunt bottle-shaped or short cylindric pycnophores (FIG. 1, *C*). The collection from Tangent, Oreg. (O.S.C. *8487*), had pycnidia with very thin outer walls, 2–2.5 μ thick; consisting of single layers of large rectangular cells. Inside of the outer layer, is a central layer, 1–3 cells thick, made up of smaller oblong hyaline cells averaging 1.3–2 μ, with the pycnophores on its inner surface.

A recent collection on *Phalaris arundinacea* from Ames, Iowa, which is assigned to *Stagonospora arenaria* differs somewhat from the others in having sepia-tinted pycnidia, which are strongly erumpent with a large ostiole. The pycnidia are 85–115 μ in diameter.

Pycnospores.—On *Arrhenatherum elatius* from Pennsylvania the spores are hyaline, cylindrical with blunt ends (FIG. 1, *A*), finally 3-septate. Oil drops adjacent to the cross walls give the spores a pseudo-chlorinous aspect. The spores are 36–44 $\times$ 2.5–4 μ, mean size 40.8 $\times$ 3.4 μ or about 12 times as long as wide. The original description (**7**) of *Stagonospora Arrhenatheri* Smith & Ramsb. gave spores 25–35 $\times$ 4 μ. Grove (**3**) reported that Ellis found spores 40–50 $\times$ 6 μ with 5–6 septa but examination of this material by the writer disclosed spores 22–35 $\times$ 3–3.8 μ and 3-septate (FIG. 1, *D*).

On *Dactylis glomerata* from Oregon, the spores are larger, hyaline, cylindrical to subfusiform 33–40 $\times$ 3.8–4.6 μ without constrictions at the septa (FIG. 1, *E*). The material sent by Cooke

has long-cylindric spores with truncated to rounded bases, 1–3 septate, 29–46 × 3.2–4 μ (FIG. 2, *D*).

The pycnospores from *Elymus glaucus* were also hyaline, cylindrical with blunt bases and obtuse (FIG. 2, *A, B, C*) or pointed (FIG. 2, *A*) apices. The spores are 3-septate, not constricted at the septa, 27–61 × 2.5–4.1 μ. The collection on *Elymus mollis* from Alaska also has cylindrical 3-septate, hyaline spores, 28–50 × 3.5–5.0 μ and differs therefore in having slightly wider spores than the collections on *E. glaucus* from Oregon and Washington.

On *Phalaris arundinacea* the spores are fusiform-cylindric to irregularly cylindric with blunt bases, 30–35 × 3.4–3.9 μ in Davis' Wisconsin material (FIG. 2, *F*). The specimen from Ames, Ia., had cylindrical to subfusiform, hyaline, 3-septate spores with small oil drops. The spores were 27–42 × 2.7–4.1 μ, mean size 35.1 × 3.2 μ or 11 times as long as wide (FIG. 2, *E*). These spores were less typical of the species but are possibly immature.

TAXONOMY

Stagonospora arenaria Sacc. was described from Sweden on *Elymus arenarius* (**6**, p. 124) with hyaline, 3-septate spores 30–35 × 3.5–4 μ in globose-lenticular pycnidia 200–250 μ in diameter. The North American material is readily referable to this species except that the pycnidia are smaller than the measurements given by Saccardo. The writer prefers to emend the original description sufficiently to include the North American material, which, otherwise, is referable to this species.

Material assigned to *Stagonospora arenaria* by European writers appears to be in some confusion with certain brown spored fungi near *Hendersonia mollis* Grove. For instance, through the courtesy of Sir Arthur Hill and Miss E. M. Wakefield of the Kew Herbarium the collections of W. B. Grove were examined. A specimen called *S. arenaria* on *Aira* from Baxterley Common, England (Oct. 15, 1927), had light brown spores 31–37 × 4–5 μ (FIG. 1, *F*). A collection by Rhodes from the banks of the Usk River at Brecon, England, was also determined by Grove as *S. arenaria*. The slide sent by Miss Wakefield showed large thin-walled pycnidia with small ostioles (10–12 μ) and hyaline, soon yellow-brown narrowly fusiform 6–7 septate spores, 40–50 × 2.5–

4.2 μ. These fungi are nearer *Hendersonia* than *Stagonospora* and have their counterpart in saprophytic fungi collected on a number of grasses in western Oregon.

Another fungus from Denmark on *Elymus arenarius, Septoria Elymi* Rostr. (**5**) was said to have 3-septate spores 38–40 $\times$ 5–6 μ, but later Lind (**4**) reported some with longer spores, 38–70 $\times$ 5–6 μ, 1–3 septate, and illustrated the spores as being narrowly fusiform, 2–3 septate, 58–67 $\times$ 2.8–4.8 μ. As illustrated (**4**), the spores are similar to those of *Stagonospora arenaria* on *Elymus*

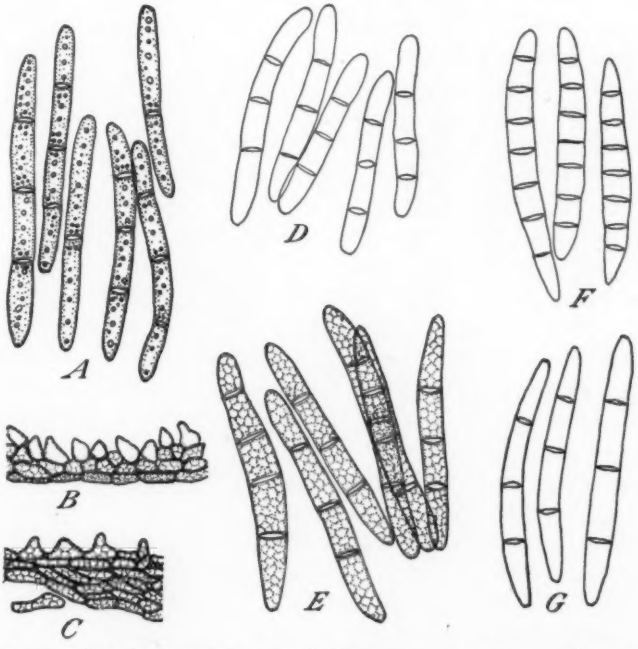


FIG. 1. *A–E, Stagonospora arenaria* Sacc. on various grasses: *A*, pycnospores from *Arrhenatherum elatius*, State College, Pa.; *B*, cross section of pycnidial wall on *Arrhenatherum elatius*, State College, Pa.; *C*, cross section of pycnidial wall on *Elymus glaucus*, Carson, Wash.; *D*, pycnospores from *A. elatius*, Hadlow Rd., Cheshire, England, and *E*, pycnospores from *Dactylis glomerata*, Wallace Bridge, Oreg. (All $\times$ 1000). *F*, pycnospores of *Hendersonia* sp. from *Aira caespitosa*, Baxterley Common, England, Oct. 15, 1927; *G*, pycnospores of *Leptosphaeria avenaria* Weber, from *Avena sativa* (Fungi Columb. *4771*). ($\times$ 1000.)

glaucus from Linn County, Oreg. (O.S.C. *8,487* and *10,746*), although less so in comparison with the more nearly cylindrical spores of the collection from Carson, Wash.

There are a number of species of *Septoria* on *Elymus* that have been described but none of them are comparable. *Septoria elymicola* Diedicke (**2**) on *Elymus arenarius* has filiform 1-septate spores 40–50 × 1–2 μ and it is near *Septoria Elymi* Ellis & Ev. as noted by Sprague (**8**). *Septoria arenaria* Rostr. on *Ammophila arenaria* has narrow spores, 100× 0.5–1.0 μ (**5**). *Septoria Ammophilae* P. Sydow (**10**) on the same host has non-septate spores 48–60 × 2 μ. While Lind (**4**) unaccountably lists this as a synonym of *Septoria Elymi* Rostr. It is distinct from other species seen. H. Sydow very kindly loaned type material of *Septoria Ammophilae* to the writer who found large, golden, hypophyllous pycnidia with curved or hooked spores.

The North American specimens are referable to the fungus described as *Septoria Elymi* Rostr., which is believed to be the same as Saccardo's ill-described *Stagonospora arenaria*. The group is assigned to *Stagonospora* rather than *Septoria* because the spores are essentially cylindrical or narrowly fusoid, and have average width to length ratios approaching 1 : 10. Also, the pycnidia in most cases are clearly thin-walled, pale brown and thus *Stagonospora*-like. Furthermore, the growth on agar media is cottony, like that of other species of *Stagonospora,* and not mucose like most species of *Septoria* on cereals and grasses. In this connection it is interesting to note that Dr. Davis (**1**, p. 425) assigned a fungus on *Elymus canadensis* from Mellen, Wis., to *Stagonospora arenaria* with the following remarks, " the leaves bear blackish brown spots, but the pycnidia are found also in paler portions of the leaves. The sporules are 20–33 × 3–4 μ, triseptate. Exceptionally 1-, 4-, or 5-septate sporules occur."

The synonomy and emended description of *Stagonospora arenaria* is as follows:

Stagonospora arenaria Sacc. (**6**) (Emended), 1878.
Syn. *Septoria Elymi* Rostr. (**5**) (Non Ellis & Ev.), 1899.
?Stagonospora Arrhenatheri Smith & Ramsb. (**7**), 1916.
Stagonospora arenaria var. *minor* Stev. & Trail (**9**), 1886.

Lesions dark purple, purple-black to deep brown, later variously mottled fading to buff or straw; pycnidia scattered not prominent, golden brown to sepia, subglobose, erumpent, ostiolate, thin-walled, 50–160(240) μ diameter; pycnophores short botuliform or subcylindric, spores cylindrical or sub-fusiform, bases often blunt tapering to a pointed to blunt apex, hyaline with small chlorine oil drops, 3-(1–4) septate, 26–61 $\times$ 2.6–5 μ, often 30–40 $\times$ 3.5–4.3 μ, smaller on *Arrhenatherum*.

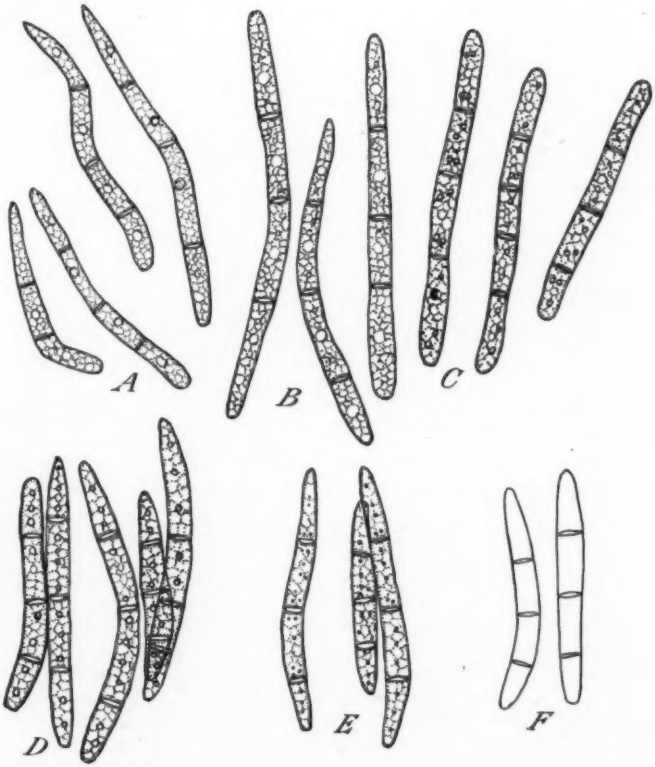


FIG. 2. Pycnospores of *Stagonospora arenaria* from various grasses: *A*, *Elymus glaucus*, Orleans, Oreg.; *B*, *E. glaucus*, Tangent, Oreg.; *C*, *E. glaucus*, Carson, Wash.; *D*, *Dactylis glomerata*, Hopkinsville, Ohio; *E*, *Phalaris arundinacea*, Ames, Iowa, Sept. 9, 1940; *F*, *P. arundinacea*, Devil's Lake, Wis. (All $\times$ 1000.)

On leaves, sheaths and culms of living plants of *Elymus arenarius, E. glaucus, E. canadensis, E. mollis, Dactylis glomerata, Arrhenatherum elatius,* and *Phalaris arundinacea* in northern Europe, Alaska, Oregon, Washington, Wisconsin, Ohio and Pennsylvania.

It should be added that *Stagonospora arenaria* is morphologically very similar to the pycnidial stage of *Leptosphaeria avenaria* Weber (*Septoria Avenae* Frank) (**11**), which is *Stagonospora*-like (FIG. 1, *G*). However, the latter fungus does not produce the purple blotching on oats as the former one does on its hosts. Furthermore, *L. avenaria* produces both pycnospores and ascospores in culture, while the writer's cultures of *S. arenaria* thus far have remained sterile. Therefore, for the present, these two fungi are considered distinct. *Stagonospora Arrhenatheri* may prove to belong to *L. avenaria* on further study.

SUMMARY

Stagonospora arenaria Sacc. causes a purple blotch leaf disease of a number of grasses in the north temperate and subarctic regions of the Northern Hemisphere. The emended concept of the species includes a somewhat polymorphic species with triseptate, narrowly cylindrical to subfusiform spores 27–70 × 2.6–5.0 μ.

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UREDINALES OF NEW GUINEA—IV [1]

GEORGE B. CUMMINS [2]

(WITH 14 FIGURES)

The 28 species of Uredinales reported in this paper were collected by Mrs. Mary Strong Clemens in Morobe District, New Guinea. Of the 28 species three are transferred as new combinations and 13 are described as new species. The type specimens are deposited in the Arthur Herbarium, Purdue University Agricultural Experiment Station.

PUCCINIASTRUM POTENTILLAE Kom.

On *Potentilla* sp., Mt. Sarawaket, April 14, 1939 (*10134*), May 1939 (*s.n.*), June 8, 1939 (*s.n.*).

Phakopsora Elettariae (Racib.) comb. nov. (*Schroeteriaster Elettariae* Racib. Par. Algen. Pilze Java's **2**: 28. 1900; *Klastopsora Elettariae* Höhnel, Zeits. Gärungsphysiologie **1**: 229. 1912.)

On *Amomum* (*Hornstedia*) sp., Kajabit Mission, Aug. 16, 1939 (*10583*), Dec. 8, 1939 (*10861*). On Zingiberaceae (probably *Amomum*), Wareo, Dec. 26, 1935 (*1370*), Jan. 3, 1936 (*1479*), Jan. 10, 1936 (*1609*), Jan. 12, 1936 (*1662*).

In 1934 Mains (Ann. Myc. **32**: 256–258) concluded that the genus *Schroeteriaster* was closely related to *Uromyces*. Descriptions of the telia of *S. Elettariae* indicate that the species is a *Phakopsora*.

PHAKOPSORA FORMOSANA Sydow.

On *Glochidion* sp., Boana, May 23, 1940 (*s.n.*), July 2, 1940 (*s.n.*).

[1] Contribution from the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

The third article of this series was published in MYCOLOGIA **33**: 143–154. 1941.

[2] I am indebted to Drs. E. D. Merrill and S. F. Blake for giving opinions concerning the identity of some of the hosts.

I have not found an adequate description of the uredia but Hiratsuka (Bot. Mag. Tokyo **49**: 785. 1935) includes the species under section *Physopella*, which is correct for the Clemens' specimens. Telia are not present.

RAVENELIA CLEMENSIAE Sydow.

On *Albizzia procera* (Roxb.) Benth., Finschhafen, Sept. 3, 1935 (*53*); Heldsbach, Sept. 9, 1935 (*s.n.*); Kajabit Mission, Sept. 18, 1939 (*s.n.*); Dec. 19, 1939 (*s.n.*); Boana, May 18, 1940 (*s.n.*).

Uromyces Cyanotidis sp. nov. (FIG. 1)

Uredia amphigena, subepidermalia, 0.2–0.5 mm. diam., sparsa vel in maculis lenissime inflatis 1–5 mm. diam. laxe aggregata, pulverulenta, cinnamomea, epidermide rupta conspicue; urediosporae ellipsoideae vel obovoideae, 21–26 × 27–38 μ; membrana 2.5–3 μ cr., obscure cinnamomea, laxiuscule sed valide echinulata; poris germ. 2, aequatorialibus, papilla hyalina obvallatis praeditis. Telia hypophylla, cinnamomea, pulvinata, 0.1–0.3 mm. diam., in greges 1–2 mm. diam.; teliosporae clavatae, ellipsoideae vel globoideae, 15–23 × 23–32 μ; membrana 1–1.5 μ cr. ad apicem 8–18 μ; aureo-brunnea, flavidula vel fere hyalina, levi; pedicello hyalino, brevi.

On *Cyanotis capitata* (Bl.) C. B. Clarke, Sattelberg, Mar. 9, 1936 (*2018*, type); Boana, May 18, 1940 (*s.n.*), June 7, 1940 (*s.n.*).

This rust was first recorded from the Philippine Islands by Cummins (Ann. Myc. **35**: 105. 1937) but was not named.

UROMYCES PHASEOLI (Pers.) Winter.

On *Phaseolus vulgaris* L., Matap station, Mar. 7, 1940 (*11253*).

PUCCINIA VERSICOLOR Dietel & Holw.

On *Andropogon contortus* L., Kajabit Mission, Oct. 1, 1939 (*10713E*).

Puccinia costina (Sydow) comb. nov. (*Uredo costina* Sydow, Ann. Myc. **14**: 355. 1916) (FIG. 2).

Telia minute, 50–80 μ diam., in groups on slightly discolored spots, subepidermal, located beneath stomata but becoming somewhat erumpent, greyish due to germination; teliospores ellipsoid or oblong, rounded at both ends or narrowed below, not or only slightly constricted at the septum, 9–14 (–16) × 23–30 μ; wall hyaline, uniformly 0.5 μ thick, smooth; pedicel short, hyaline and

fragile. The teliospores germinate immediately and apparently lack differentiated germ pores.

On *Costus* sp., Mosum to Lae, July 7, 1939 (*s.n.*); Boana, May 10, 1940 (*11368*), June 12, 1940 (*s.n.*).

The teliospores of this species are the most delicate of any known to me and can easily be overlooked unless numerous.

PUCCINIA FERRUGINEA Lév.

On *Smilax* sp., Galumbu-Finangan, Apr. 25, 1940 (*s.n.*)

Puccinia heroica sp. nov. (FIG. 10, 11)

Pycnia epiphylla, profunde immersa, 125–175 × 325–500 μ. Aecia amphigena in maculis leniter incrassatulis usque ad 1 cm. diam. profunde im-

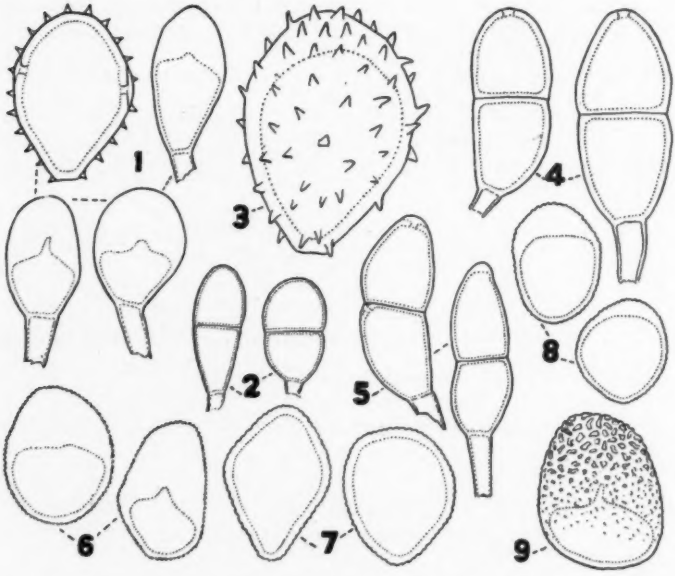

FIG. 1, teliospores and one urediospore of *Uromyces Cyanotidis;* 2, teliospores of *Puccinia costina;* 3, urediospore of *Puccinia largifica;* 4, teliospores of *Puccinia Evodiae;* 5, teliospores of *Puccinia Buchnerae;* 6, aeciospores of *Aecidium wareoense;* 7, aeciospores of *Aecidium elaeocarpicola;* 8, aeciospores of *Aecidium albiceratum;* 9, aeciospore of *Aecidium pachycarpum* (× 650).

mersa, breviter cylindracea, 350–450 μ, diam.; cellulis peridii oblongo-ellipsoidei, 35–45 × 50–75 μ, pariete interiore grosse verrucoso 4–7 μ cr., exteriore levi 5–10 μ cr.; aeciosporae globoideae vel oblongo-ellipsoideae, 35–48 × 45–65 μ; membrana pallide flavida, 2.5–4 μ cr., ad apicem 9–16 μ, grossiuscule verrucosa. Telia hypophylla, subepidermalia, 0.5–2.0 mm. diam., flavida, maculis flavidis 2–4 mm. diam. occupantibus, epidermide rupta elevata; teliosporae cylindraceae, non vel vix constrictae, 18–23 × 69–96 μ; membrana ubique 1.5 μ cr., flavidula, levi; pedicellis concoloris, 12–25 × 100–175 μ, deorsum plus minusve attenuatis. Statim germ.

On *Loranthus* sp., Matap station, Mar. 6, 1940 (*11245*).

The telia of this species occupy the center of yellowish spots which have a somewhat corky appearance. They lack the usual appearance of telia and apparently this is also true of fresh material, since Mrs. Clemens failed to observe them and only accidentally gathered them with the host material. *P. heroica* is generally similar to *P. macrocarya* Racib., as regards teliospores, but the aeciospores are larger, more coarsely marked and have a pronounced apical thickening.

PUCCINIA MACROCARYA Racib. (FIG. 12, 13)

Pycnia epiphyllous, subepidermal, deep-seated, globoid or flask-shaped, paraphysate, 150–250 μ diam. Aecia hypophyllous or becoming amphigenous, subepidermal, deep-seated, 0.3–0.5 × 0.5–1 mm., short-cylindric but the peridium usually broken off, grouped on pulvinate galls 2–8 mm. diam.; peridial cells rhomboidal, 30–45 × 50–75 μ, inner wall coarsely rugose, 5–6 μ thick, outer wall nearly smooth, 8–10 μ thick; aeciospores angularly globoid or broadly oblong, 33–39 × 39–46 μ; wall hyaline, 3–4 μ thick, closely and rather coarsely verrucose. Uredia unknown and probably not formed. Telia amphigenous, occurring singly, pulvinate, 0.4–1.0 mm. diam.; teliospores cylindric or oblong-cylindric, rounded at both ends or somewhat narrowed below, not or very slightly constricted at the septum, 23–30 × 72–89 μ; wall yellowish or nearly hyaline, uniformly 2–3 μ thick, smooth; pedicel concolorous, 13–23 μ wide and up to 170 μ long, thick walled, 3–6 μ. The spores germinate at once.

On *Loranthus* sp., Yoangen, June 18, 1936 (*3381b*); Sugu-Gaeng, Apr. 29, 1940 (*s.n.*).

Although Raciborski's description (Par. Algen Pilze Java's **3**: 11. 1900) is brief I feel confident that this New Guinea rust is *P. macrocarya*. He gives the aeciospores as 38 × 44 μ, the telio-

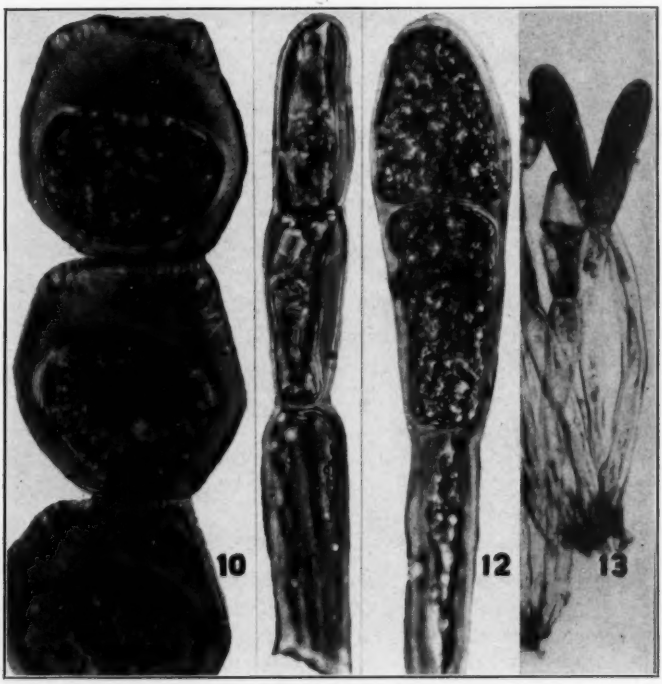

FIG. 10, aeciospores of *Puccinia heroica;* 11, teliospore of *Puccinia heroica;* 12, teliospore of *Puccinia macrocarya* (× 800); 13, teliospores of *Puccinia macrocarya* (× 250).

spores as 20–24 × 70–90 μ and the pedicel as 24 μ wide and up to 180 μ long. The Sydows (Monog. Ured. 1: 589. 1903) state that they did not see the specimen and I find no record of its subsequent collection. For these reasons the above description is provided.

Puccinia Evodiae sp. nov. (FIG. 4)

Pycnia, aecia et uredia nulla vel adhuc ignota. Telia hypophylla, subepidermalia, 125–200 μ diam., castaneo-brunnea, tumores 1–2 mm. diam. occupantibus; teliosporae ellipsoideae vel oblongo-ellipsoideae, utrinque rotundatae vel deorsum attenuatae, medio leniter constrictae, 17–23 × 35–45 μ; membrana ubique 1.5–2 μ cr., castaneo-brunnea, levi; pedicello pallide brunneolo, sporam aequante vel breviore.

On *Evodia* sp., Yunzaing, Aug. 17, 1936 (*3898*).

The characteristic feature of *P. Evodiae* is the small corky gall in which the telia develop. Judging from the description *P. kentaniensis* Pole Evans is similar to this species but has smaller spores. Doidge (Bothalia **2**: 95. 1926) notes that "the corky excrescences in which the teleuto-sori are embedded very much resemble insect galls, and might be passed over as such by the mycologist." This statement applies equally well to *P. Evodiae*.

Puccinia Buchnerae nom. nov. (*Uredo cumula* Arth., Bull. Torrey Club **49**: 195. 1922. Not *Puccinia cumula* Arth. & Cumm. 1933). (FIG. 5).

Telia non visa; teliosporae in uredia ellipsoideae, utrinque plus minusve rotundatae, medio constrictae, 10–13 × 28–38 μ; membrana pallide cinnamomea, 0.5 μ cr., ad apicem 2–2.5 μ cr., levi; pedicello hyalino, sporam breviore, fragili.

On *Buchnera* cf. *urticifolia* R. Br., Boana, May 15, 1940.

This species was previously reported (Mycologia **32**: 373. 1940) under the name *Uredo cumula* Arth.

Puccinia largifica sp. nov. (FIG. 3, 14)

Uredia hypophylla, sparsa, subepidermalia, flavida, 0.1–0.2 mm. diam.; urediosporae obovoideae 25–38 × 38–48 (–56) μ; membrana pallide flavida vel hyalina, 2.5–3 μ cr., ad apicem 8–14 μ, valde aculeata; poris germ. obscuris. Telia hypophylla, subepidermalia, pulvinata, rotundata, 0.1–0.2 mm. diam., castaneo-brunnea; teliosporae oblongo-ellipsoideae, utrinque plus minusve rotundatae, medio constrictae, 27–32 × 65–97 μ; membrana 1.5 μ cr., ad apicem 3–6 μ cr., castaneo-brunnea, levi; poro superiore apicali, inferiore juxta septum sito; pedicello hyalino sporam aequante sed fragili.

On *Senecio glossophyllus* Mattf., Mt. Sarawaket, Mar. 14, 1939 (*10030*), Apr. 13, 1939 (*10137B*), May 1939 (*10293D* type), June 3, 1939 (*s.n.*).

I have only relatively meager specimens of this distinctive rust but Mrs. Clemens has indicated on one of the packets that it is common in her 1937 collection. This material is presumably in the Berlin Museum and will ultimately become available.

UREDO OPERTA Sydow & Butler.

On *Coix lachryma-jobi* L., Wantoat, Jan. 18, 1940 (*11015*).

FIG. 14. Teliospores of *Puccinia largifica* (× 800).

Uredo Polliae sp. nov.

Uredia hypophylla, subepidermalia, flavo-brunnea, 0.13–0.3 mm. diam., sparsa vel laxe aggregata in maculis brunneis; urediosporae ellipsoideae vel late ellipsoideae, 23–25 × 26–29 (–32) μ; membrana flavida, 1.5 μ cr. moderate echinulata; poris germ. 2, aequatorialibus.

On *Pollia* near *sorsogonensis* (E. Mey.) Steud., Kajabit Mission, Oct. 3, 1939 (*10714*).

Uredo pseudocannae sp. nov.

Uredia hypophylla, subepidermalia, peridio flavidulo cincta, poro aperta, 80–120 μ diam., in maculis pallide brunneis 2–10 mm. longis laxe aggregata; urediosporae ellipsoideae, obovoideae vel late ellipsoideae, 18–21 × 23–29 μ; membrana pallide flavida vel hyalina 1.5 μ cr., moderate echinulata; poris germ. obscuris.

On *Canna indica* L., Sattelberg, Feb. 28, 1936 (*1908*).

The urediospores have a general resemblance to those of *Puccinia Cannae* (Wint.) P. Henn. but the sori are much smaller and provided with a cellular peridium. Discovery of telia may prove

the species to be similar to or perhaps synonymous with *Phakopsora Elettariae*.

Uredo Passiflorae sp. nov.

Uredia hyophylla, subepidermalia, rotundata, 0.125–2.0 mm. diam., flavida, epidermide primo tecta, in maculis pallidis laxe aggregata vel sparsa; urediosporae ellipsoideae vel obovoideae fere sessiles, 16–23 × 23–28(–33) μ; membrana pallide flavida vel fere hyalina 1–1.5 μ cr., moderate echinulata; poris germ. obscuris.

On *Passiflora* sp., Malalo Mission, Salamaua, May 27, 1936 (*3186*).

UREDO ERIGERONTIS Arth. & Cumm.

On *Erigeron sumatrensis* Retz., Boana, Aug. 21, 1938 (*8721A*); Ogao, June 20, 1939 (*10360*); Samanzing, July 5, 1939 (*10432*).

Short, brownish, peripheral, knob-like paraphyses united below to form a cellular peridium are present in this species, although not mentioned in the original description (Phil. Jour. Sci. **61**: 484. 1936). Future collections should be examined for phakopsoroid telia.

Aecidium innuptum sp. nov.

Pycnia nulla. Aecia hypophylla, subepidermalia, cupulata, pallide flavida, 150–225 μ diam., in maculis pallidis 3–7 mm. diam. aggregata; cellulis peridii late ellipsoideis vel oblongo-ellipsoideis, 14–18 × 19–26 μ, pariete interiore moderate verrucoso 1.5–2 μ cr., exteriore striato 3 μ cr.; aeciosporae globoideae vel ellipsoideae, 11–15 × 14–19 μ; membrana 0.5–1 μ cr. hyalina, minuteque verruculosa.

On *Aristolochia* sp., Matap station, Feb. 6, 1940 (*11107*).

Aecidium elaeocarpicola sp. nov. (FIG. 7)

Pycnia amphigena, subepidermalia, 100–150 μ diam., paraphysata. Aecia hypophylla, profunde immersa, non exserta, 0.2–0.3 mm. diam., in maculis leniter incrassatulis 2–8 mm. diam. aggregata; cellulis peridii haud bene evoluti laxe conjunctis in sporas transeuntibus; aeciosporae variabiles, late ellipsoideae, ellipsoideae vel oblongae, ad apicem et basim frequenter attenuatae, 18–26 × 30–45 μ; membrana pallide brunnea 2 μ cr., moderate verrucosa.

On *Elaeocarpus* sp., Sattelberg, May 1936 (*3024*).

A. elaeocarpicola causes less marked hypertrophy than *A. Puspa* Racib. or *A. Elaeocarpi* Racib., has shorter aeciospores with no apical thickening and has a poorly formed peridium.

AECIDIUM ELAEOCARPI Racib.

On *Elaeocarpus* sp., Sattelberg, Apr. 9, 1936 (*2277*).

The aeciospores of this species are united laterally in uniform horizontal series as well as in vertical chains and tend to separate readily into horizontal strata, somewhat as the teliospores in the microcyclic *Alveolaria*.

Aecidium wareoense sp. nov. (FIG. 6)

Pycnia epiphylla, subcuticularia, 125–200 μ lata, 50–75 μ alta, paraphysata. Aecia hypophylla, cupulata vel breviter cylindracea, 0.2–0.3 mm. diam., albida, in maculis brunneis 3–12 mm. diam. aggregata; cellulis peridii rhomboideis, 20–30 × 30–40 μ pariete interiore verrucoso 4–7 μ cr., exteriore striato 2.5–4 μ cr.; aeciosporae globoideae, plus minusve cuboideae vel oblongae 16–23 × 19–29 μ; membrana hyalina 2 μ cr., ad apicem 7–14 μ, verrucoso.

On *Meliosma ferruginea* Blume, Wareo, Jan. 7, 1936 (*1554*, type); Sattelberg, Mar. 26, 1936 (*2168a*); Yunzaing, June 29, 1936 (*3457*).

While the aecia of *A. wareoense* have the gross appearance of those of *A. Meliosmae-myrianthae* P. Henn. & Shirai the apically thickened spores are entirely different. The fragile peridium of *A. Meliosmae-pungentis* P. Henn. & Shirai and of *A. hornotinum* Cumm. will prevent confusion with *A. wareoense*.

Aecidium Toxocarpi sp. nov.

Pycnia epiphylla, subepidermalia, 150–200 μ lata, 200–300 μ alta. Aecia hypophylla, in maculis pallidis 2–10 mm. diam. laxe aggregata, cupulata; cellulis peridii oblongis vel oblongo-ellipsoideis, 12–18 × 20–30 μ, pariete interiore rugoso 3–3.5 μ cr., exteriore levi 2 μ cr.; aeciosporae late ellipsoideae, ellipsoideae vel oblongae, 15–22 × 22–27 μ; membrana 1–1.5 μ cr., ad apicem usque ad 8 μ cr., pallide flavida vel fere hyalina, minuteque verrucosa.

On *Toxocarpus* sp., Kajabit Mission, Dec. 15, 1939 (*10882*).

AECIDIUM DICHROCEPHALAE P. Henn.

On *Dichrocephala* sp., Finangan to Lapisap, Apr. 26, 1940 (*s.n.*).

This collection, consisting of only two leaves, was gathered by Mrs. Clemens " for distributional record " but the rust which she had collected elsewhere and considered to be identical is microscopically quite different and is described below.

Aecidium matapense sp. nov.

Pycnia hypophylla, subepidermalia, paraphysata, 90–135 μ diam. Aecia hypophylla, in maculis pallide brunneis 0.3–10 mm. diam. aggregata, flavida, cupulata, 0.15–0.25 mm. diam., margine recurvato; cellulis peridii rhomboideis vel oblongo-ellipsoideis, 18–26 × 29–37 μ, pariete interiore moderate rugoso-verrucoso 2.5–3 μ cr., exteriore striato 3–4 μ cr.; aeciosporae globoideae vel late ellipsoideae, 16–19 × 18–24 μ; membrana hyalina vel pallide flavidula, 1 μ cr., ad apicem 2.5–6 μ, moderate verrucosa.

On *Dichrocephala latifolia* DC., Matap station, Mar. 6, 1940 (*11246*).

Aecidium albiceratum sp. nov. (FIG. 8)

Pycnia non visa. Aecia hypophylla, in maculis flavidis vel brunneis 2–4 mm. diam. denseque aggregata, cupulata 0.25–0.35 mm. diam.; cellulis peridii rhomboideis vel ellipsoideis, 16–25 × 26–38 μ, pariete interiore 2.5–3.5 μ cr. rugoso, exteriore 3–5 μ cr. striato; aeciosporae globoideae, ellipsoideae vel oblongo-ellipsoideae, 16–20 × 20–29 μ; membrana 1.5–2 μ cr., ad apicem 3–8 μ cr., hyalina, moderate verrucosa.

On *Senecio* sp., vicinity of Samanzing, Dec. 10–20, 1938 (*10342W*).

AECIDIUM? PACHYCARPUM Sydow. (FIG. 9).

On *Senecio* sp., vicinity of Ogao, June 1, 1939 (*10371*).

This specimen differs from *A. pachycarpum* in lacking pycnia and in having peridial cells with thinner walls. The aeciospores are 20–26(–29) × 26–33(–36) μ with the wall 1.5–2 μ at the base but greatly thickened apically to as much as 23 μ. The collection contains but a single infected leaf but Mrs. Clemens notes indicate various collections in 1937, the specimens presumably at the Berlin Museum.

THE ARTHUR HERBARIUM,
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

NEW OR LITTLE KNOWN ASCOMYCETES COLLECTED IN SÃO PAULO IN 1936

ANNA E. JENKINS, HELMUT P. KRUG, AND EDITH K. CASH

(WITH 3 FIGURES)

On January 12, 1936, the first two writers of this paper made an excursion to the Biological Station of the State of São Paulo, at Alto da Serra (between São Paulo and Santos), particularly to learn whether *Corynelia brasiliensis* Fitzpatrick was present on *Podocarpus* growing there, and, if so, to gather material of it. This fungus was not found, but two other described fungi were discovered on other plants growing naturally in this moist mountainous area. The following May another mycological excursion was made to Itanhaen (south of Santos).[1] Among the fungi collected in this littoral region of the State of São Paulo were two Discomycetes, one, described, although rarely collected, the other new, and undescribed. These were studied by the third author of this paper.

1. MAIREELLA BERTIOIDES (Sacc. & Berl.) Maubl.

The first of the two fungi collected at Alto da Serra attracted attention because of the bright yellow discolorations it produced particularly on the upper surface of leaves of a comparatively small vine. This apparently young plant was not in flower, and, at first, from the infected leaves selected as a mycological specimen, could be identified only as perhaps a Composite.[2] Through the subsequent determination of the fungus, however, it became apparent that the host genus was *Mikania,* and the species, *M. hirsutissima* D.C. This native Brazilian Composite, which is considered to be

[1] During the period that these excursions were made the senior writer was stationed in São Paulo and was working in coöperation with A. A. Bitancourt, Assistant Director, Instituto Biologico de São Paulo.

[2] Identification by E. P. Killip, United States National Herbarium, Washington, D. C.

medicinal (**2**, **13**, p. 265), has the common name of "cipo cabeludo" (hairy vine) (**13**, p. 265).

Near the centers of the discolored leaf areas, as well as occasionally on the petioles and young stems, were perithecia, often clustered, although sometimes standing apart from the group, or entirely solitary. These perithecia were globose to subglobose, and generally dull black, although occasionally they were glistening (FIG. 1, *A*, *a* and *b*). In some cases these fruit bodies were collapsed as shown in figure 1, *A*, *c*. On many of the leaf spots the perithecia had fallen away, and, through the hand lens, dark, circular areas where they had been attached could be seen. As many as twenty points of attachment were counted in the central part of an individual lesion. Although the bases of caespitose perithecia were separate or more or less so, the perithecia themselves were often closely joined together (FIG. 1, *F*). Nearly the entire circumference of the perithecial cavity was lined with numerous asci and filiform paraphyses. The asci were generally clavate and thickened at the apex, with the spore bearing part narrowed abruptly to the short slender stipe (FIG. 1, *D*). In some cases the asci had elongated becoming cylindrical, with walls of even thickness. The spores were here uniseriate, instead of biseriate or inordinate as in the unextended ascus.

The fungus was first traced to *Maireella maculans* Sydow (**7**, p. 146). This genus and species were established in 1908 to classify an ascomycete also from Alto da Serra, collected by Usteri. The host was reported as of unknown identity, but apparently a Composite. Upon further examination of the literature it was ascertained that during his stay in Rio de Janeiro, Maublanc (**8**) had also discovered this same ascomycete on several species of a climbing Composite of the genus *Mikania*, notably *M. hirsutissima*, growing on the slopes of Corcovado Mountain. In connection with Maublanc's identification of this species of *Maireella* he made a careful monographic study of the genus. This was named in Maire's honor by Sydow, who discovered that the name selected by Maire was preoccupied. The original generic description (**7**, p. 145) reads as follows:

"Peritheciis astomis, superficialibus, ut in Cucurbitaria caespitosis."

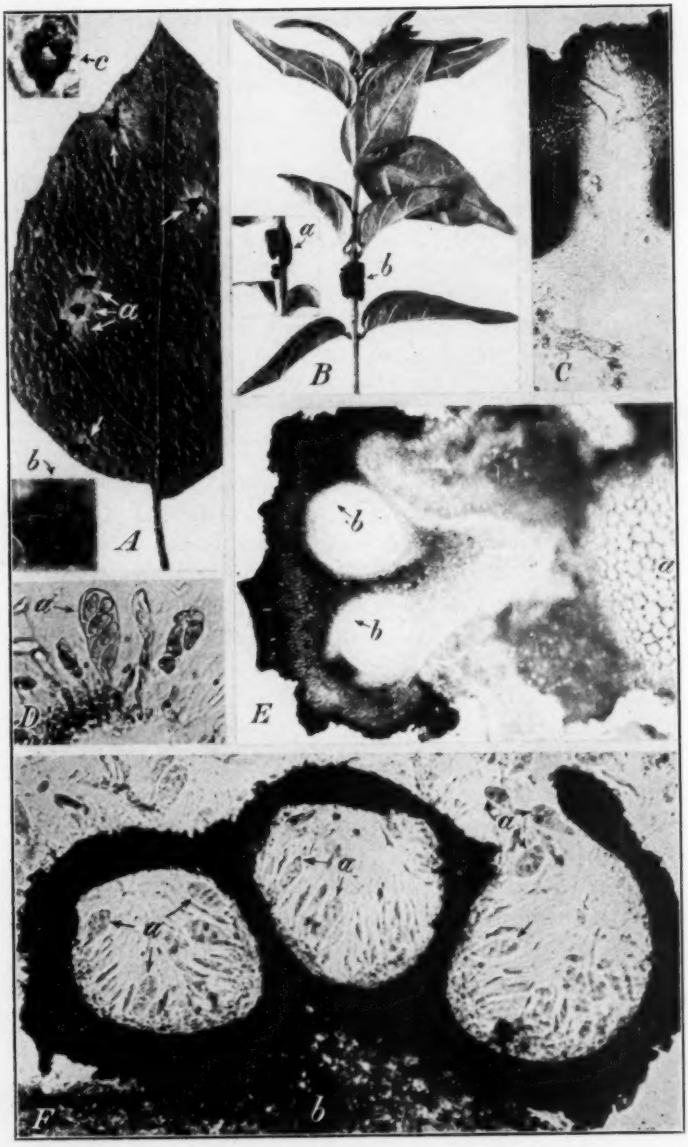

FIG. 1

Maublanc's (**8**, p. 128) revised description is quoted below:

"Stromata foliicola, erumpentia-superficialia, pulvinata, atra, centro ad folium adfixa, verrucosa-rugulosa, pilis rigidis saepe deciduis ornata; contextu celluloso; mycelio in matricem evoluto, intercellulare, septato-moniliforme. Loculi globosi, plus minusve e stromate erumpentes, ostiolati, tunica a contextu stromatico non distincta. Asci cylindracei vel clavati, 8-sp., paraphysati. Sporidia oblonga, medio 1-septata, hyalina, demum fuscescentia."

The earliest published name for *Maireella maculans* found by Maublanc was that of *Lizonia bertioides* Sacc. & Berl. (**16**, p. 157), which is based on a specimen collected near Santos by Balansa. Maublanc accordingly made the combination *M. bertioides* (Sacc. & Berl.). Besides the synonyms just named two others reported by Maublanc are *Parodiella caespitosa* Wint.,[3] for which Spegazzini **18**, p. 37) erected the new genus *Winteromyces*, and *Lizonia Uleana* Sacc. & Sydow (**21**, p. 79). Both species were described from specimens collected by Ule in the region of São Francisco, Santa Catharina. This was one of Ule's several places of residence in that state upon his arrival in Brazil from Germany in 1883, and before he went to Rio de Janeiro to live in 1891 (**3**). The *Parodiella* was originally described on leaves of an undetermined climbing Composite, and *L. Uleana* on leaves of *Mikania* sp.

Judging from the description, which corresponds well with *M. bertioides*, there exists a third binomial representing Ule's collection of this fungus, namely, *Dimerosporium aeruginosum* Wint. (**26**, p. 87). Winter cited Ule *245*, São Francisco, in his technical description. Ule's collection number *229* is cited for *Lizonia Uleana* by the authors of this species. Apparently at least two other specimens on leaves of *Mikania* collected by Ule were identified as

[3] Rabenhorst-Winter fungi europaei No. 3249 (1885). In Mycological Collections of the Bureau of Plant Industry, Washington, D. C.

FIG. 1. The two fungi from Alto da Serra. *A*, *D*, and *F*, *Maireella bertioides* on *Mikania hirsutissima*. *A*. Black perithecia clustered on yellowed areas on upper leaf surface. *a*, × 1; *b*, × 9; *c*, × 5. *D*. Part of inner layer of perithecium showing asci (g). × 200. Section through fruit body showing three perithecia. *a*, asci, paraphyses shown indistinctly. *F*, *b*, host tissue, × 125. *B*, *C*, *E*. *Haplosporella Justiciae* on *Justicia* sp. *B*, *a* and *b*, × 1; *C*. Section through fruit body showing ostioles opening, × 115. *E*. Section showing attachment of fruit body to host tissue (*a*), and two locules with indefinite contents (*b*) as described by Petrak and Sydow for the specimen collected by Ule, × 35. Photographs by M. L. F. Foubert.

D. aeruginosum, for under this name Pazschke (**10**) lists Ule *167*, October 1884, and Rehm (**15**) Ule *167a*. Under the name, *Parodiella dothideoides* Pat., Rehm also lists Ule *47*, collected on leaves of *Mikania*. Pazschke also listed "*Parodiella caespitosa* Wint. Rabh. Fung. Eur. No. *3249*. Ad fol. Compositae Aug. 84. No. *47*.?" It is possible that "Ule No. *47*" in Rehm's list is of the same gathering as the type of *P. caespitosa*. In Theissen's (**22**) treatment of the genus *Dimerosporium*, *D. aeruginosum* is excluded and referred to *Antennularia*.

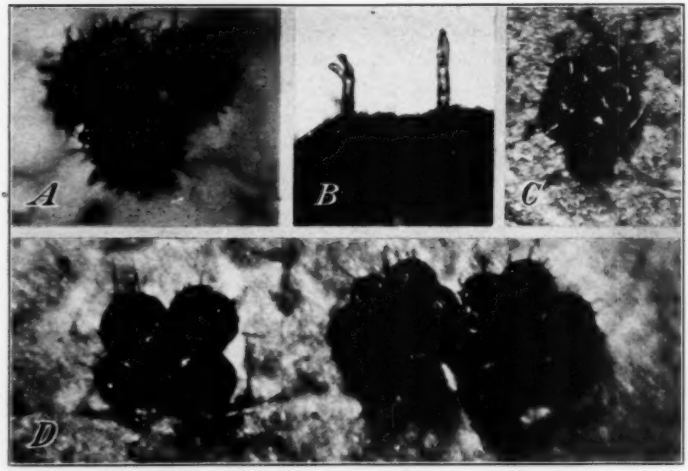

FIG. 2. *A* and *B*. Setae of *Maireella melioloides* on *Mikania* sp. as present on the type specimen of *Dothidella Mikaniae*, São Paulo, May 18, 1901, *A*. Puttemans No. *230*. *A*, × 70; *B*, × 300. *C* and *D*. Setae of *M. bertioides* on *Mikania microlepsis* from Parana, Aug. 14, 1911, P. Dusen. *C*, × 30; *D*, × 60. Photographs by Foubert.

Maublanc recognized a second species of *Maireella*. This was found on leaves of *Mikania* sp. in Rio de Janeiro by Ule, and in the Cantareira Mountains near the city of São Paulo by Puttemans (May 16, 1901, Puttemans *230*). In the latter case the fungus was described by Hennings (**4**, p. 111) as *Dothidella Mikaniae*. Reviewing the additional taxonomic history of this species, Maublanc made for it the combination of *M. melioloides* (Rehm).

Drawings of both *Maireella melioloides* and *M. bertioides* were published by Maublanc. The setae of *M. melioloides* represented are from the specimen collected by Puttemans mentioned above, and a photograph of the same specimen as represented in the Mycological Collections of the Bureau of Plant Industry is here shown in figure 2, *A* and *B*. This shows the numerous setae on the fruit body including the branched setae, observed by Maublanc. The delicate setae of *M. bertioides* shown in figure 2, *C* and *D*, are present on the specimen from Paraná to be cited presently.

As a result of examining certain phanerogamic specimens of *Mikania* from southern Brazil, filed in the United States National Herbarium, Washington, D. C., several additional records of *Maireella*, apparently *M. bertioides*, have been obtained. These specimens, together with their accession numbers (U. S. Nat. Herb.) are cited below.[4] It will be noted that one specimen is from the state of Parana. Although the date of the specimen from Rio de Janeiro is not given, this is between 1831–38, which is the period during which Miers was in Rio de Janeiro. The *Maireella* in this phanerogamic collection constitutes at once an early record of this fungus and one of the early mycological records for Brazil. The early specimen of José de Campos Novaes, who was referred to by Puttemans (**14**, p. 26), adds Campinas, São Paulo, to the distribution of the fungus, while its occurrence in Campos do Jordão in the same state is shown by the specimen gathered by the North American uredinologist, E. W. D. Holway and his wife, Mrs. Mary W. Holway. Two other comparatively early specimens available from Brazil are from São Leopoldo, in the State of Rio Grande do Sul. The first was collected in 1906 by Theissen (Theissen, Decades fungorum brasiliensium *147*) and the other, cited by Maublanc (**8**, p. 399), by Rick (Rick, Fungi Austro-Americani *323*). Not in all cases on the material exam-

[4] *Mikania argyrei* DC. Rio Cumpriolo, Rio de Janeiro, Federal District, J. Miers 3648. Ex Herb. Miers (U. S. Nat. Herb. 1420920). Campos do Jordão, São Paulo, Apr. 23, 1922, E. W. D. & Mary M. Holway 1089 (U. S. Nat. Herb. 1119726[1]).

Mikania hirsutissima DC. Campinas, São Paulo, Campos Novaes 40 (U. S. Nat. Herb. 389581).

Mikania microlepsis Baker Morretés, Marumby, Parana, Apr. 14, 1911, P. Dusén 12043 (U. S. Nat. Herb. 1281094).

ined were the fructifications of the *Maireella* accompanied by the conspicuous yellow leaf discolorations already mentioned.

A few weeks after making their first gathering of *M. bertioides* at Alto da Serra, Krug and Jenkins returned to select more material for purposes of study, but most of the fruit bodies had fallen and new ones had not developed. During October, 1940, the second author of the paper visited Alto da Serra where he again saw the *Maireella* on *Mikania hirsutissima* at the Biological Station, as well as elsewhere in the forest nearby. At still another place in the vicinity of São Paulo (Parque do Estado) he also collected the fungus on leaves of *M. sericea* Hook. The two collections were compared with the gathering from Alto da Serra of 1936, by Ahmés P. Viégas, who found them to be identical with the specimen collected in 1936.

During the course of the present study it has been discovered that two Ascomycetes discovered and described by F. L. Stevens, viz., *Achorella guianensis* (**19**, p. 15–16) and *A. costaricensis* (**20**, p. 30) are actually of the genus *Maireella*. The first species is from British Guiana and the second from Costa Rica. Detailed drawings of the first species accompany its description. The second species also is illustrated, but asci and spores are not shown. Typical material of *A. guianensis* is at hand, and F. L. Stevens' prepared slides of *A. costaricensis* have been lent by Neil E. Stevens of the University of Illinois. However, asci or ascospores have not been found in the sections represented.

Achorella guianensis is clearly a distinct species of *Maireella*. Macroscopically it is of the same general appearance as *M. bertioides*, but the spores are distinct. They are longer and more slender than those of *M. bertioides* and are noticeably pointed at the apices. The measurements given in the original description are 22–29 × 5–7 μ. For *M. bertioides* Maublanc gave the spore measurements of 18–25 × 8–11 μ and for the smaller spored and otherwise distinct species *M. melioloides*, those of 14–18 × 5–6 μ.

Petrak (**11**, p. 210–211) has recently shown that *Uleodothis andina* Chardon (**1**, p. 246) is a species of *Maireella*, and that it is distinct from *M. bertioides*. He therefore made the combination *M. andina* (Chardon). This fungus as originally described on leaves of *Mikania ruiziana* Poepp. from Colombia was apparently

immature for the spores are described as hyaline. From Chardon's illustrations and measurements of the spores this Colombian species is similar to **M. guianensis** (Stev.) comb. nov. Jenkins.

Achorella costaricensis was described on *Mikania* sp., collected at Cartago, Costa Rica, in 1923. As a record of *Maireella* this is somewhat earlier than two other specimens available from that country. The phanerogamic specimens concerned are " Plants of Costa Rica Nos. *43463* and *43464*," collected in the vicinity of Santa Maria de Dota, Province de San José, by Paul C. Standley, and Juvenal Valeri, Dec. 26, 1925–Jan. 3, 1926. The first specimen, *Mikania* sp., was examined as filed in the U. S. National Herbarium. The fungus on the leaves is here immature and conidial locules containing minute conidia as described for *A. costaricensis* are present. Several leaves representing the second specimen, *Mikania Skutchii* Blake, were found in the Mycological Collections of the Bureau of Plant Industry, where the mature ascomycete thereon had been identified as *Dimerosporium aeruginosum* by R. W. Davidson. This specimen is in agreement with *M. bertioides* and it is here so identified. *A. costaricensis*, with ascospores described as 21–25 $\times$ 10 μ, and " Plants of Costa Rica " No. *43463–4* are probably also *M. bertioides*.

Maire stated that *Maireella maculans* was a composite *Parodiella* and that it corresponded in the Perisporiales to *Otthia* of the Sphaeriales. Maublanc (**8**) reviewing the systematic position of the fungus under its different designations gave as his opinion that its affinities were with Dothideales, where it had been classified by Theissen (**23**), and Theissen and Sydow (**24**, p. 466). Essentially the same opinion as to *Achorella guianensis* was expressed by F. L. Stevens in connection with his description of this fungus. He commented as follows:

" The general characters of this fungus are Dothideaceous. . . . The hypostroma is Dothideaceous in character and often the stroma is so, too, the perithecia touching each other and fusing (fig. 24), thus the locules with undifferentiated walls appear in a stroma. In other instances spherical perithecia develop upon the stroma, only partially or not at all attached to their neighbors. In such cases the fungus appears Sphaeriaceous rather than Dothideaceous and it clearly represents a border-line form between the two groups."

Petrak (**11**) also believes that the fungus is dothideaceous but he is of opinion that further research bearing on the systematic position of the genus *Maireella* should be made.

2. HAPLOSPORELLA JUSTICIAE P. Henn.

The second fungus gathered at Alto da Serra occurred as black protrusions (FIG. 1, *B*) on green stems of a low growing plant in bloom, which was later identified as *Justicia* sp. by E. C. Leonard of the U. S. National Herbarium. Sections revealed that the deep-seated protrusions, reaching to the pith of the host plant (FIG. 1, *E, a*), contained locules opening to the surface by a long neck (FIG. 1, *C* and *E*). The locules which it seemed should contain asci, were unfortunately empty, except for indefinite light colored masses lining these cavities (FIG. 1, *E, b*). In this condition the fungus was recognized as an imperfect, described by Hennings (**5**, p. 385) on the basis of Ule's collection of it in the Amazon region. The name of the fungus and the diagnosis are quoted as follows:

"Haplosporella Justiciae P. Henn. n. sp.; stromatibus carbonaceis, epidermide caulis subhemisphaerico-pulvinatis serie erumpentibus, atris, tuberculato-rugulosis, rimosis, 1½–2½ mm. diam.; perithecis immersis, globulosis; conidiis cylindraceis, curvulis, obtusis, eguttulatis, hyalino-fuscidulis, 4–5 × 1 μ, conidiophoris hyalinis, brevibus.

"Rio Madeira, St. Maria: An Stengeln von Justicia cynantha Lind. März 1902, No. 3064.

"Das Conidienstadium gehört zweifellos zu einer Dothideaceae, die Stromata brechen reihenweise aus der Rinde der lebenden Stengel in schwarzen Polstern hervor. Die Conidien sind durch Form und Grösse sehr abweichend; doch vermag ich die Art vorläufig nur hierher zu stellen."

Petrak and Sydow (**12**, p. 343–344), studying the type specimen of *Haplosporella Justiciae*, failed to find conidia. Their description of the fungus is practically in agreement with the illustrations of it here shown. Relative to the fruit layer they state that this is young, and composed of a hyaline filamentous mass. They noted that Hennings first described this fungus "in sched." as an unripe *Dothidea*, then as *Dothiorella Justiciae* P. Henn. before describing it as *Haplosporella*. They state further that in the structure of the stroma and perithecia the fungus greatly resembles *Apioporthe virgultorum* (Fries) Hoehnel, and also that it appears to have a *Diaporthe*-nucleus and may belong to this or a related genus.

Under the circumstances Petrak and Sydow stated that *Haplosporella Justiciae* P. Henn. should be dropped from the literature. It is unfortunate that the specimen from Alto da Serra is in no better condition that Ule's original gathering in the Amazon region.

3. DERMATEA PARASITICA (Wint.) Hoehnel (FIG. 3, *A–B*)

A fungus collected on leaves of Melastomataceae [5] from Itanhaen agrees in every detail with the fungus described by Winter (**25**, p. 173) as *Niptera parasitica* and later referred by Hoehnel (**6**, p. 1524) to *Dermatea*. Comparison with the type specimen, collected by E. Ule in 1883 on leaves of Melastomataceae near São Francisco, Santa Catharina, Brazil, and issued as Rabenhorst Fungi europaei et extraeuropaei *3167*, confirmed this identification. As noted by Hoehnel (l.c.), Spegazzini also studied the same fungus from collections made by Puiggari in Apiahy 1882–1888 (nos. *2757–2931*) and described it under the name *Fabraea? Melastomacearum* (**17**, p. 590).

Whether the various foliicolous discomycetes referred to *Dermatea* should be retained in this genus is doubtful, but pending a critical revision of such species, this record of the 1936 collection is made under Hoehnel's name.

4. **Laetinaevia Blechni** sp. nov. (FIG. 3, *C*)

Apothecia hypophyllous, subepidermal, elliptic to oblong in outline, 0.5–1 × 0.5 mm., or confluent and reaching 2–3 mm. in length, arranged in closely parallel rows at the margin of the pinna or extending from the midrib to the margin and forming blackened spots 3–5 × 1–3 mm.; hymenium buff citrine, drying bone brown or fuscous to black (Ridgway), opening by a longitudinal slit, remaining sunken and surrounded by the torn discolored epidermis of the host which makes an undulating, whitish border; asci cylindrical, gradually narrowed toward the base and apex, 75–90 × 10–13 μ; spores irregularly biseriate, hyaline, 2-celled, with one small guttule in each cell, not constricted, broadly fusoid or biconic, sometimes unsymmetrical and irregular from crowding in the ascus, 15–18 × 7–9 μ; paraphyses hyaline, septate, filiform, 2 μ in diam., thickened and yellow at the tips and coalescing to form a dense yel-

[5] Identification by S. F. Blake, U. S. Department of Agriculture, Washington, D. C.

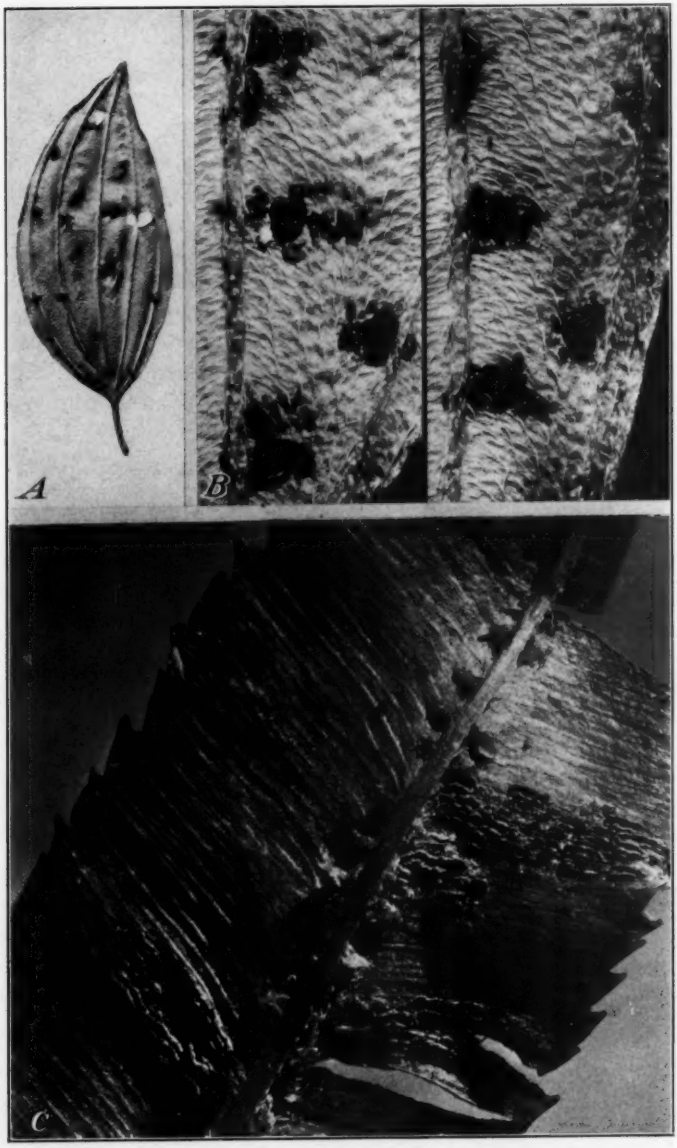

FIG. 3

low mazaedium; hypothecium golden yellow, plectenchymatic, extending deep into the host tissue, outer layer thin, composed of small, thin-walled cells, adnate to host tissue at the sides.

On *Blechnum serrulatum*[6] Rich., Itanhaen, São Paulo, Brazil, H. P. Krug, A. E. Jenkins and A. S. Costa, May 11, 1936, Inst. Agr. Campinas Herb. Secc. Phytopath. no. *1561*. Type material also in the Mycological Collections of the Bureau of Plant Industry, Washington, D. C.

Apothecia hypophylla, subepidermicalia, elliptico-disciformia, 0.5–1 mm. longa, 0.5 mm. lata, in lineis parallellis disposita, et maculas nigrifactas 3–5 mm. longas, 1–3 mm. latas formantia, longitudinaliter scindentia et hymenium alutaceo-citrinum, siccum atrobrunneum, epidermide lacerato undulati circumdatum patefacientia; asci cylindrici, basim et apicem versus attenuati, 75–90 μ longi, 10–13 μ lati; ascosporae irregulariter 1–2-seriatae, uniseptatae, late fusoideae vel biconicae, 15–18 μ longae, 7–9 μ latae; paraphyses hyalinae, filiformes, apice flavae, coalescentes; hypothecium aureo-flavidum, plectenchymaticum; cortex tenuis, lateraliter ad epidermidem adnatus.

According to the Saccardian classification, this fungus would be placed in the genus *Diplonaevia*, since the spores show a definite median septum. It is pointed out by Nannfeldt (**9**, p. 191) that little dependence can be placed upon the variable character of spore septation in delimiting genera in some groups of discomycetes; he therefore includes in his genus *Laetinaevia* various species of *Diplonaevia* and *Phragmonaevia* having septate spores.

SUMMARY

Maireella maculans Sydow (1908) on *Mikania hirsutissima* DC. was rediscovered at Alto da Serra, São Paulo on Jan. 12, 1936, by Krug and Jenkins. This is the type locality for the species so named, for which the genus *Maireella* Sydow was established. To the synonymy of the fungus, now known as *M. bertioides* (Sacc. & Berl.) Maubl., is added *Dimerosporium aeruginosum* Wint., based on a specimen collected at São Francisco, Santa Catharina, by Ule. *Parodiella caespitosa* Wint. and *Lizonia Uleana*

[6] Identification by W. R. Maxon, U. S. National Museum, Washington, D. C.

FIG. 3. *A–B, Dermatea parasitica* on Melastomataceae, *A*, × 1, *B*, × 8; *C, Laetinaevia Blechni* on *Blechnum serrulatum*, × 8. Photographs by Foubert.

Sacc. & Sydow, which Maublanc placed as synonyms of *M. bertioides*, were also described from specimens from this same source.

Additional records of this pathogenic species are available as a result of examining certain phanerogamic herbarium material of *Mikania* spp. These are from southern Brazil and in one instance from Costa Rica. Moreover, *Achorella costaricensis* F. L. Stevens on *Mikania* sp. from Costa Rica is identified as probably this species of *Maireella, M. bertioides.*

Setae of both *Maireella bertioides* and *M. melioloides* including a branched setum of the latter, described by Maublanc, are represented photographically. These are the only species in the genus as monographed by Maublanc.

A second species of *Achorella* described by F. L. Stevens, viz., *A. guianensis* on *Mikania* sp. from British Guiana, is transferred to the genus *Maireella* by the senior author. *Uleodothis andina* Chardon on *M. Ruiziana* from Colombia, which was described somewhat later than *A. guianensis* and which was recently transferred to the genus *Maireella* by Petrak, appears to be similar to *M. guianensis.*

Haplosporella Justiciae on *Justicia* sp. was also collected at Alto da Serra. Formerly this fungus was known only from the Amazon region, where it was discovered by Ule in 1902. Petrak and Sydow, studying Ule's specimen, reported in 1912 that the fruit layer in this specimen was of indefinite character and that the name *H. Justiciae* P. Henn. should therefore be dropped. The more recent gathering from Alto da Serra is unfortunately in no more favorable fruiting condition.

Dermatea parasitica (Wint.) Hoehnel, described from material found in Santa Catharina by Ule in 1883 and also collected by Puiggari in Apiahy, 1882–1888, was found by Krug, Jenkins and Costa at Itanhaen in 1936 on leaves of Melastomataceae.

The other of the two Discomycetes collected at Itanhaen occurs on *Blechnum serrulatum;* this appears to be new and is described by the third author as *Laetinaevia Blechni.*

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A NEW UREDINELLA FROM CEYLON

JOHN N. COUCH

(WITH 12 FIGURES)

The genus *Uredinella* was described in 1937 (Mycologia **29**: 665) from rather scanty material collected by the writer in South Carolina. Soon after this paper appeared, Mr. T. Petch sent me two fine collections of this genus from Ceylon and recently Dr. George Weber has sent from Florida an abundant collection of the original species. The purpose of this paper is to describe the new species from Petch and to present some new information about the old one.

Uredinella spinulosa Couch & Petch, sp. nov.

Maculae minutae, 0.8–1.8 mm. diam., orbiculatae, effusae, annuae ad folias arborum frondosarum, facile separabiles; colore griseo-castaneo vel brunneo; contextu firmo, sicco, 50–270 μ crasso. Teleutosporae globosae vel pyriformes, brunneae, circa 15–21 μ, germinantes apice foramen distincto et formantes cylindricum, 3-septatum basidium, 6.3–7.5 × 63–72 μ; sterigmata 7 μ, sporae curvae, ellipticae 4.6–5.4 × 21–23 μ. Sporae similes teleutosporis sed cylindricae, etiam formatae, quae longe ellipticas parce curvas sporas generant. Hymenium cum setis, 9.2–14.7 × 130–230 μ.

Hab. supra Coccidas supra folias Psychotriae sp. Ceylon.

Forming minute, circular, flat patches, 0.8–1.8 mm. wide on the upper and lower surfaces of living leaves of *Psychotria* sp., always overgrowing and parasitic on a scale insect. Easily separable from the leaf. Color chestnut brown toward outer part, grayish near center due to formation of hyaline allantoid spores. Margin sharply determinate, about 80–100 μ wide, only a few threads in thickness, very pale brownish. Texture firm, dry, brittle. Surface smooth, velvety and even except for a distinct mound over the insect. In section up to 250 μ thick through center of insect, 50–105 μ thick beyond insect and to marginal region where hymenium is single, 160–170 μ thick where hymenium is stratose or double layered; composed of a hymenium and a subiculum, the latter made up of compactly arranged septate, brownish hyphae, 4.5–5.5 μ thick, which extend radially. Hymenial cells of two

FIG. 1. *Uredinella spinulosa.*

kinds: one is a deep brown, thick-walled, spherical or pyriform teleutospore, the other an elongated, somewhat thinner-walled, brown teleutospore-like structure which gives rise to an allantoid spore. These two types of spores may be formed on the same or

on separate thalli. When found on the same thallus, the two types of cells intergrade into one another in regard to shape and thickness of wall. Spherical teleutospores are usually not arranged in a compact hymenium; 15–21 μ thick, smooth or with very minute warts at apex and distinct apical germ pore; also with stalk cell which remains attached to teleutospore even when thallus is crushed and spores are separated from thallus. Basidia apparently arising from spherical or pyriform teleutospores (none seen attached), cylindrical, 4-celled, with pointed apical cell, 6.3–7.5 $\times$ 63–72 μ, sterigmata about 7 μ long. Basidiospores bent-elliptic, hyaline, smooth, 4.6–5.4 $\times$ 21–23 μ. The elongated teleutospore-like cells are arranged in a compact hymenial layer. These spores are club-shaped and thickest at the apex or not infrequently they may be thickest at the base, and smooth or very minutely warted at the apex. Due to the thinner wall the germ pore is less distinct than in the spherical teleutospore; 8–12.6 $\times$ 29–42 μ, without a separate stalk cell; germinating to form an allantoid hyaline spore, 3.8–5 $\times$ 45–58 μ. Intermingled with both types of resting spores are numerous, thick-walled, dark brown, blunt tipped, unbranched, and non-septate setae, 9.2–14.7 $\times$ 130–230 μ. The setae may be scattered over the entire thallus but are usually more abundant over the insects.

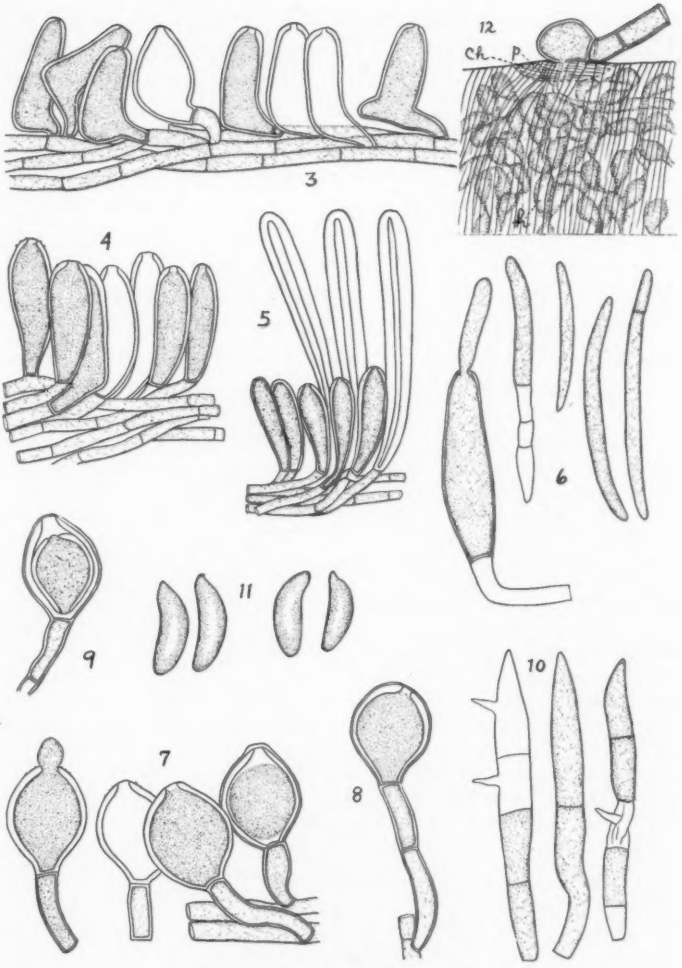
Associated with scale insects (*Aspidiotus* sp.), one parasitized insect being beneath each patch of fungal growth. Haustoria irregularly coiled and composed of sausage-shaped segments. Penetration apparently directly through insect's skin.

Ceylon: Nuwara Eliya; on leaves of *Psychotria* sp., parasitizing scale insects; August 28, 1926. Again on same host January 16, 1927. T. Petch coll. Type in University of North Carolina Herbarium and British Museum, London.

This fungus is easily recognized as a species of *Uredinella* and may be distinguished from *U. coccidiophaga* by its small size, occurrence on leaves, smooth or minutely warted, globose to subglobose teleutospores, and above all by the conspicuous spines. The haustoria and penetration through the derm rather than in the mouth region are also distinctive.

In *Uredinella coccidiophaga* the allantoid spores were binucleate and arose from binucleate cells. The allantoid spores were considered homologous to uredospores and the cell which gave rise to this spore was called the uredospore mother cell. It has not been possible in the material from Ceylon to determine if the allantoid spore

FIG. 2. *Uredinella coccidiophaga.*



FIGS. 3–12. *Uredinella spinulosa.*

is binucleate when formed or if it arises from a binucleate cell. We may assume, however, that the allantoid spores in the two species are homologous. In *U. spinulosa* the allantoid spore becomes several times septate, some of the partitions becoming empty.

On January 10 I received from G. F. Weber, Gainesville, Florida, an abundant collection of *U. coccidiophaga* growing on scale insects on *Myrica cerifera*. This fungus was originally described as growing in discoid patches 0.2–1.5 mm. wide. The patches in the Florida material, however, were much larger, varying from 1.6–3.8 mm. wide. They were also so abundant as to show up conspicuously even without magnification. The patches were circular or irregular in outline with a nearly smooth or more frequently minutely cracked surface, without setae. The basidia and spores were exceedingly abundant in this material and typical.

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EXPLANATION OF FIGURES

FIG. 1. *Uredinella spinulosa* on *Psychotria*. The circular darker spots are the fungus; the elongated whitish bodies are the scales of unparasitized insects. × 2. FIG. 2. *Uredinella coccidiophaga*. Coll. by G. F. Weber, Fla. Two pieces below, x n. s.; one piece above, × 2. Small, dark, rounded patches are the fungus. Each patch covers one parasitized scale insect. Some of the larger patches are composed of two, three, or even more small patches. On lower right of piece to right is *Septobasidium castaneum* and on upper right of piece to left is *S. sinuosum*. FIGS. 3–12. *Uredinella spinulosa*. 3, 4, hymenia showing elongated teleutospore-like cells × 585; 5, hymenium with setae, × 367; on left 6, elongated thin-walled teleutospore-like cell germinating to form allantoid spore, × 635, on right four allantoid spores, one of which has become septate, × 585; 7–9, spherical to pyriform teleutospores, each with stalk, distinct germ pore and thick wall, in 9 is shown what appears to be internal proliferation of new teleutospore within wall of old, × 635; 10, basidia, note sterigmata and pointed distal end of basidium, × 635; 11, basidiospores, × 635; 12, showing where fungus had penetrated (*p*) insect's derm, chitinous (*ch*) deposit around first cell formed, and haustoria (*h*), × 635.

NOTES ON COPRINUS MICACEUS GROWING IN AN UNUSUAL HABITAT

S. M. Pady

The conditions which permitted *Peziza domiciliana* to develop during the winter of 1937–38 [1] were also favorable for the growth and development of *Coprinus micaceus,* during the winter of 1938–39 and 1939–40. The mushrooms appeared in exactly the same locality, on the floor of a room in a residence, in a narrow strip ½″ wide and 9″ long, bounded by linoleum on one side and a porcelain fixture on the other, and the same room conditions of temperature, light and moisture prevailed. Observations were begun in the fall of 1938 at about the time the first ascocarps of *P. domiciliana* had previously appeared. Ascocarps, however, did not appear at this time nor at any time during the winter or spring. On January 25th, 1939, three mushrooms were observed, two being old and withered, and one in an active stage of growth. This fungus, which proved to be *Coprinus micaceus,* was present almost continuously until late spring. Growth was resumed in October, 1939, and continued throughout the winter and spring. The mycelium of *Peziza* had either died out or had been crowded out, because no apothecia have since appeared.

Table I shows the number of specimens which appeared from January 25th, 1939 to March 27th, 1939. The number of mushrooms maturing at one time was not large, usually one or two. Higher numbers were not common although sometimes they did occur, as for example 4 on October 26th, 1939, 5 on November 12th and 5 on December 11th. The total number of mushrooms which appeared during this particular time (October 13th to December 12th) was 35, indicating apparently optimum conditions. Growth periods were generally followed by a resting period. The two resting periods shown in Table I were approximately 14 days

[1] Pady, S. M. Observations on the rate of growth of ascocarps of *Peziza domiciliana.* Mycologia **31**: 53–55. 1939.

in length. At other times the resting period was shorter, twice being recorded for 7 days. In general these resting periods which incidentally showed no periodicity in their occurrence, lasted from two to three weeks.

TABLE I

SHOWING NUMBERS OF SPECIMENS OF COPRINUS MICACEUS AND STAGES IN THEIR DEVELOPMENT

Date	Buttons	Developing	Mature	Date	Buttons	Developing	Mature
Jan. 25	?	?	1	Feb. 25	3	3	—
Jan. 26	3	—	1	Feb. 26	—	6	—
Jan. 27	1	2	—	Feb. 27	1	6	—
Jan. 28	1	1	1	Feb. 28	—	6	1*
Jan. 29	1	1	—	Mar. 1	—	4	3
Jan. 30	1	—	1	Mar. 2	—	—	—
Jan. 31	1	—	—	Mar. 3	—	1	3
No development during this period				Mar. 4	—	1	1
Feb. 15	5	—	—	No development during this period			
Feb. 16	3	2	—	Mar. 20	2	—	—
Feb. 17	3	2	—	Mar. 21	1	1	—
Feb. 18	3	1†	—	Mar. 22	1	1	—
Feb. 19	3	1	—	Mar. 23	1	—	1
Feb. 20	5	1	—	Mar. 24	1	—	1
Feb. 21	5	1	—	Mar. 25	—	1	—
Feb. 22	5	—	1	Mar. 26	—	—	—
Feb. 23	5	—	1	Mar. 27	—	—	1

* Removed for study.
† Died.

In most cases notes and measurements were taken at approximately the same time each evening; however, more frequent observations were made sometimes in order to make a more detailed study of the rate of growth. At certain times the maturing sporophore seems to grow more rapidly, as in mushroom No. 2 (Table II) when the increase in height between February 27th, and 28th was 57 mm. as compared with an increase of 12 mm. the previous day and 15 mm. the following day. In this mushroom the additional measurements give a more detailed picture of the growth rate during this period. Considerable variation was observed in the height of mature specimens, ranging from 40 mm. to 110 mm. Almost as soon as the mushrooms had shed their spores they began to wilt, the pileus withered and in a few hours the mushrooms had collapsed. Deliquescence was rare due probably to the high tem-

peratures although in some cases the outer portion of the pileus deliquesced; in most cases the mushroom simply dried up.

Although *Peziza* and *Coprinus* had appeared in the same locality and under the same conditions, differences soon became apparent. In the former many incipient apothecia appeared, of which only 2 or 3 would mature; in the latter only a few buttons were developed, but practically all matured. The time required for a single fructification to reach maturity was approximately 21 days in the case of *Peziza*, as compared with 5–7 days for *Coprinus*. Fruiting was

TABLE II

GROWTH RATES OF INDIVIDUAL MUSHROOMS

No. 1

Jan. 26/39	10:30 P.M.	Small button
27	10:30 P.M.	Button
28	10:30 P.M.	4–5 mm. above floor
29	8:30 P.M.	12 mm. above floor
	12:30 A.M.	14 mm. above floor
	10:30 P.M.	18 mm. Pileus 15 mm. high
30	9:30 A.M.	35 mm.
	5:30 P.M.	65 mm.
	9:30 P.M.	78 mm. Pileus 25 mm. high, 32 mm. wide
31	9:30 A.M.	110 mm. Pileus flattened, 45 mm. wide
	10:30 P.M.	collapsed

No. 2

Feb. 24	10:30 P.M.	Button
25	11:30 P.M.	3–4 mm.
26	11:30 P.M.	5–6 mm. Pileus 10 mm. wide
27	11:30 P.M.	18 mm. Pileus 14 mm. wide
28	11:30 P.M.	75 mm. Pileus 35 mm. wide
Mar. 1	10:30 P.M.	90 mm.
2	10:30 P.M.	removed

thus protracted and continuous, while in *Coprinus* the fruiting periods were intermittent, due no doubt to the depletion of food resources by the rapidly growing mushrooms.

It has been difficult to determine the source of the moisture supply. The room was heated by a burner using Texas natural gas and thus the moisture content, as well as the temperature, was maintained at a high level. This heated moisture-laden air, on striking the cold water pipes and a cold water container, resulted in considerable condensation. Since only a small fraction of this moisture dripped into the crack where the fungi were growing, it was evident that there was some other source of moisture. There

was very little evidence of rotting wood except in the crevice itself. In June, 1940, the linoleum was removed and the plumbing checked. It was discovered that there was a poor connection in the water pipe just at the floor level which allowed a small but apparently constant amount of water to be lost. A small area in the hardwood flooring, approximately $9'' \times 2''$, was rotted through but beyond this point the moisture had caused a very superficial rotting of the floor under the linoleum in a circular area with a radius of about $2'$. The rotted wood when removed was found to be standard oak flooring. Since no plumbing repairs had been made for the last five years, and possibly longer, and since fungi were observed there in the fall of 1937 it would appear that the amount of moisture had been sufficient to maintain an ideal substratum for a limited fungus population over a period of several years.

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THE GENERA OF THE BOLETACEAE[1]

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(WITH 1 FIGURE)

Even though new classifications of any group of fungi are looked upon with hearty disfavor in certain quarters and are to be deprecated under any conditions unless such changes are quite necessary, it has for some time been obvious that certain changes in the arrangement of the *Boleti* are desirable. The scheme most widely used in Europe and America up to quite recently has been the one including four genera, as follows: *Gyrodon, Strobilomyces, Boletinus* and *Boletus*. The first two genera have contained only one species each, *Boletinus* has had 12 and *Boletus* about 150 species distributed in 13 subgroups. This arrangement is comfortable because of long usage. It has been at all usable, however, only because *Gyrodon lividus* has not been found on this continent, *Strobilomyces strobilaceus* is readily recognized, and because most of the species of *Boletinus* are either likewise readily recognized, or with some degree of facility segregated from the species of *Boletus* by a single character. On the other hand, the more the group is studied and the more new species are found, the less sensible and the less practicable the scheme becomes.

In this country thus far, the genus *Gyrodon* has been dismissed as entirely European. The likewise monospecific *Strobilomyces* has been characterized as having tubes not easily separable from the flesh, pileus and stipe variously and more or less scaly, flesh tough, and spores globose, brown and reticulate. Other than the spores, these characters are not definitive. The single species of the genus is fundamentally black and thus it is easily recognized, but blackness is not a valid generic character.

The characters now used to distinguish the genus *Boletinus* read well and sound convenient, but at least one of them is not even

[1] This paper is essentially the same as the one read at the meetings of the National Academy of Sciences at Brown University, October 25, 1939 (see Abstract in Science N.S. 90, 2340: 412. Nov. 3, 1939).

valid. The tube-layer of some species is about as easily separable from the flesh as any of the species of *Boletus*, and on the other hand, the tube layer of many species of *Boletus* is separable with as great difficulty as in some of the species of *Boletinus*. The tubes of most *Boletini* are compound but those of many species of *Boletus* also are. The best character is the radial arrangement of the tubes and especially the more or less complete presence of radial veins or lamellae, at least near the stipe. In this particular, however, we have difficulty. Peck (**7**), for example, placed the species *spectabilis* in *Boletus*, but he said (**6**) that this species along with *Boletinus pictus* and *B. paluster* formed a natural group. Murrill placed *spectabilis* in *Boletinus* (**5**), because the tubes are occasionally radiately arranged. Some collections, however, will not show this character at all. More recently two collections sent in from the Pacific Coast gave considerable trouble in attempts at identification, because they were decidedly boletinoid in this respect, but they plainly turned out to be *Boletus Lakei*. Again, there is the case of what Peck described as *Boletus amabilis*, with a note that "the tubes have a radiating structure as in the genus *Boletinus*" (**8**, p. 612) but that he desired to obtain more data before placing it there. Some species of *Boletus* are obviously very close to *Boletinus*. In fact, the subgroup Viscipelles of the genus *Boletus* and *Boletinus* run together at several points.

The genus *Boletus* is certainly a conglomerate of groups of species (Peck's tribes), which differ more from one another than the Viscipelles do from *Boletinus*. For example: Viscipelles (*B. granulatus, B. americanus, B. luteus, B. piperatus*, etc.), with viscid to glutinous pileus, small, elliptical and hyaline to yellow or greenish spores; Calopodes, Luridi and Edules, with bulbous stipe for the most part, yellow tubes and subfusiform spores mostly yellow under the microscope and ochraceous to brownish in mass; Versipelles (*B. scaber, B. versipellis, B. aurantiacus*, etc.), with white tubes, relatively long, scabrous stipe, and large, more or less naviculate, brownish spores; Cariosi (including *B. castaneus* and *B. cyanescens*), with imputrescible carpophore, tubes white becoming yellow, hollow stipe, spores short-elliptical, hyaline, and yellow in mass. Not only do these subgroups differ greatly one from another, but they may be of different phylogenetic origins, as witness

Roger Heim's statement that the Boletaceae in the Friesian sense are ". . . un groupement artificiel de formes à convergence hyméniale, en réalité d'origines très diverses . . ." (**2**, p. 19).

In this situation, which is becoming more unsatisfactory the more one studies the *Boleti*, if one is not to remain a slave to usage some change is desirable, if not absolutely necessary upon phylogenetic grounds. There are three sorts of change possible. One is to retain all the species in one genus *Boletus*, as has been done by Sartory and Maire (**10**).

The second possibility is dismemberment and increase in the number of genera—especially, division of the genus *Boletus* along lines that have already been used for decades or as may appear justified by further study. This treatment for the most part involves the raising of the various subdivisions of *Boletus* made by Fries and elaborated by Peck to genera, in a more or less complete fashion.

The third possibility is in the nature of a compromise—to accept some of the subgroups as distinct genera and others as subgenera of the genus *Boletus*.

The first arrangement would probably satisfy no one. It would not only be a change from present practice, but it is not consonant in any way with mycological progress in the past hundred years to include in a single genus species with all sorts of superficial characters and with all sorts of form and ornamentation of spores, to say nothing of their colors, and hence to consider the fleshiness of the carpophore and the tubular nature of the hymenophore as the only definitive generic characters. Such an arrangement would offer no advantages in the identification of species. Further, if by any chance the family is a convergent group representing different phylogenetic origins, a single genus would be ridiculous.

Of several schemes of dismemberment proposed in the last 40 years, only one has been promulgated on this side of the Atlantic—that by Murrill (**5**) based more or less on that of Karsten (**3**). This scheme consists of 11 genera, 4 of them new. The genus *Boletus* is split into 8 genera (3 new) largely on the basis of color of the spores in mass, and presence or absence of glandular dots and annulus on the stipe. Not only have these characters not been considered as valid for generic segregation by any student of

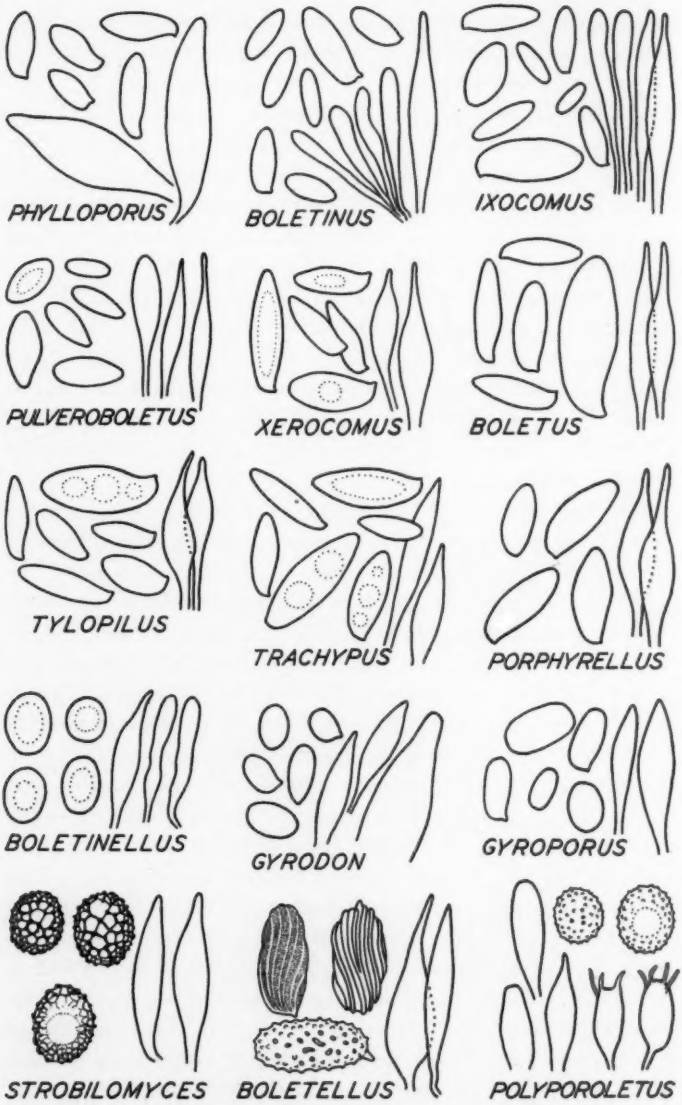

FIG. 1. Typical spores and cystidia of the genera of the Boletaceae, with basidia for *Polyporoletus*. Spores × 1000, cystidia and basidia × 500.

the group, but further the result of their use is 7 small genera and a hodgepodge genus, *Ceriomyces*, containing 48 of the 80 species in his family. Three of Murrill's new genera, however, are acceptable.

Of the several other new schemes proposed in Europe, only one has had any substantial recognition in recent years—that of Gilbert (**1**), in turn a modification of that of Quélet (**9**). After long and troubled cogitation upon the subject, the writer has been impelled to bring himself to the adoption of this scheme in all but a few details. Unanimous acceptance of this proposal in this country there certainly will not be, but for conscientious objectors on grounds of long-established usage, or of constitutional dislike of "revisions," there is easy escape—the adoption of the scheme of Konrad and Maublanc [possibility three above (**4**)]. Those who insist upon retaining the present scheme of four genera can merely reduce the new genera to subgenera to parallel the Friesian-Peck arrangement in use at present. The change from any one of these schemes to any other would be simple.

For the present writer, then, the Boletaceae will be made up of subfamilies, subgroups and genera characterized by a combination of gross features of the carpophore and spore morphology (see figure 1 for illustrations of the spores and cystidia). The arrangement follows:

Subfamily BOLETEAE—with smooth spores.

EUBOLETEAE—with hymenophore lamellate, boletinoid or tubulate, with tubes compound or simple, and spores long-elliptical or subfusiform and colored.

Genus 1. *Phylloporus* Quélet, consisting of the single species, *P. rhodoxanthus*.

This genus appears to the writer to be a good one and seems to be better placed in the Boletaceae than with the Paxilli. It has the superficial appearance of a bolete, and is invariably picked casually as one, and in addition to the anastomosing lamellae, it has definitely boletoid spores and cystidia.

Singer (**11**, pp. 169–170) has placed in this genus one species (*squarrosoides*) which the writer still retains in *Boletinus*,

at least until further studies can be made of the boletinoid species.

Genus 2. *Boletinus* Kalchbr.—as now constituted, except for the segregated genus *Boletinellus,* and such species as may be added to it from the following genus, with tube layer more or less lamellate and tubes more or less radiately arranged, and with spores narrowly elliptical and thin-walled.

Genus 3. *Ixocomus* Quélet—the Viscipelles of Fries and Peck, with viscid or glutinous pileus, compound tubes not radiately arranged and not at all separated by lamellae, and spores narrowly elliptical.

Genus 4. *Pulveroboletus* Murr.—the Pulverulenti of Peck (*B. hemichrysus, B. Ravenelii* and *B. auriflammeus*), with surface of pileus and stipe more or less pulverulent, tubes simple, and spores small, ellipsoid to ovoid.

It may be that this genus will be better established when more is known about the presence or absence of a veil and its connection with the pulverulence.

Genus 5. *Xerocomus* Quélet—the Subpruinosi and Subtomentosi of Fries and Peck, which groups the writer finds useful enough to retain as subgroups of the genus.

The surface of the pileus is dry, never viscid, and glabrous, subpruinose or subtomentose; the tubes are compound or simple as far as studied; the spores are subfusiform. The stipe is never reticulate or subbulbous and the tubes are never stuffed or with red mouths, as in the groups of *Boletus.*

Genus 6. *Boletus* Dill. ex Fries—including the Calopodes, Edules and Luridi of Fries and Peck, which will be retained as subgroups, as they have been by Gilbert (**1**) and by Konrad and Maublanc (**4**). Other than the distinctive characters of these subgroups (reticulate stipe and adnate tubes, stuffed tubes, and red tube-mouths, respectively), the genus is in general characterized by sporophores rather stout and robust, tubes simple, stipe stout and more or less bulbous, especially at first, and spores subfusiform.

Genus 7. *Tylopilus* Karst.—the Hyporhodii of Fries and Peck. Gilbert (**1**) rejected this genus on the ground of insufficiency of distinguishing characters, which are solely the flesh-colored tubes and spores. Konrad and Maublanc, however, accepted the genus. There is no gainsaying Gilbert's logic, but the writer is inclined to include the genus because of the ease with which it can be recognized and also because such a segregation reduces the bulk of the genus *Boletus*.

Genus 8. *Trachypus* Bataille (for the preëmpted *Krombholzia* Karsten, and as having priority over *Krombholziella* R. Maire)—the Versipelles of Fries and Peck, with tubes white, at least at first (or possibly yellow if *rugosiceps* is included), stipe more or less slender and tapering and scabrous, and spores in general more or less naviculate.

Genus 9. *Porphyrellus* Gilbert—for the pilose, reddish-spored *B. porphyrosporus* and *B. fumosipes*, formerly of the Favosi.

GYRODONTEAE—with hymenophore more or less boletinoid and more or less lamellate, tube layer thin (tubes short to very short), and spores small and oblong to short-elliptical or nearly subglobose, colored.

Genus 10. *Boletinellus* Murrill, a segregate from *Boletinus*, with very lamellate, merulioid hymenophore and very broadly elliptical, thick-walled spores, including *B. merulioides* (*porosus*) only.

Singer (**11**, pp. 37 & 171) combined this genus with *Gyrodon* and perhaps rightly so, but for the present at least, it is being kept distinct by this writer.

Genus 11. *Gyrodon* Opat.

Until quite recently, this genus has included only one species (*lividus*) growing under alders in Europe. Singer (**11**) recently placed *Boletus sphaerosporus* Peck here because of the spores, and made a new subgenus *Paragyrodon* for it. The writer was for some time inclined to erect a new genus for this and three other species with very small, short-ellipsoid

spores like those of *Gyrodon,* because our species do not seem to be imputrescible, the tubes are not unusually short nor consistently large, the stipes are not always slender nor do they enlarge particularly into the pileus, and clamps have not with certainty been found, but he now believes it would be better to place them in *Gyrodon.* These other species are: **G. californicus** (Murr.), *comb. nov.,* **G. Ballouii** (Peck), *comb. nov.,* **G. tennesseensis** Snell & Hesler, *comb. nov.,* and **G. Housei** (Murr.) *comb. nov.*

LEUCOSPORELLEAE—with carpophore imputrescible, hymenophore tubulate, tubes simple, at first white and then usually yellow, stipe customarily becoming hollow, and spores white or yellow in mass, small, hyaline, oblong or short-elliptical.

Genus 12. *Gyroporus* Quélet—the Cariosi.

Subfamily STROBILOMYCETEAE—with ornamented spores.

Genus 1. *Strobilomyces* Berk.—as heretofore, with globose, reticulated spores.

Genus 2. *Boletellus* Murr.—with spores large, elliptical, longitudinally striated or wrinkled, or verrucose, including *B. Ananas,* the Laceripedes (*B. betula* and *B. Russellii*), **B. chrysenteroides,** and **B. subflavidus** (Murr.) *comb. nov.*

Genus 3. *Polyporoletus* Snell—the polyporoid *P. sublividus,* with spherical, verrucose spores.

Extra-limital genera of Boleti are as follows: the tiny Javan *Filoboletus* Henn.; the huge Madagascan *Phlebopus* Heim; and the Cameroonian *Fistulinella* Henn. and the Madagascan *Ixechinus* Heim, both of the latter with discrete or fistulinoid tubes.

The writer is not yet ready to follow Gilbert completely. This estimable French mycologist has erected a new order Boletales (1), arranged as follows: suborder Boletineae, with the families Paxillaceae (genus *Paxillus*), Boletaceae (other genera than noted here), Leucosporellae (*Gyroporus*) and Gyreae (*Gyrodon* and *Boletinellus*); suborder Strobilomycetineae, family Strobilomycetaceae (*Boletellus* and *Strobilomyces*). In this scheme there is more subdivision into families than American mycologists wish to digest for

the present, although there is much to be said for placing the Paxillaceae near the Boletaceae.

This new classification proposed for adoption is not perfect. There are more monospecific genera than might be desired. There are some species that appear to cross generic lines and one or two genera that appear to be composite and perhaps unnatural, but further rearrangements will without doubt iron out many of the discrepancies, especially upon the completion of studies of microscopic details and ontogenetic development, possibly chemical or even serological studies, etc. It is to be expected that there would be more difficulty in fitting our 160-odd species into any framework than it is for the Europeans with about 50 species. On the other hand, the scheme is more sensible and more in accord with modern concepts. It is believed that the spore characters are more fundamental than some of the superficial, macroscopic features now used as a basis of classification, and while amateur mycologists without a microscope may not be so well served as formerly, the family is on a sounder foundation and accurate identification of species will be facilitated.

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DATA ON THE CULTURAL CHARACTERISTICS OF A SPECIES OF COPRINUS

G. T. Johnson[1] and Asa C. Jones

INTRODUCTION

In 1928, Frear, Styer, and Haley published a study of the effect of hydrogen-ion concentration on the growth of *Agaricus campestris*. Even at that late date the authors could state (p. 91), "Very little investigational work has been done on the growing of mushrooms in artificial media." The statement is still true as far as field mushrooms are concerned. Both generic and specific cultural requirements of members of the group vary a great deal, and the writers hope that the facts obtained during the culture of a *Coprinus*, and reported below, will be of interest in this regard.

MATERIALS AND METHODS

The organism studied was isolated in 1936, by the senior author, from soil collected in Costa Rica by Dr. C. W. Dodge.[2] Pure cultures of the plant were utilized in experiments designed to measure the effect of different cultural conditions upon its growth. The amount of mycelium (dry weight) produced in nutrient solution and the number of sporophores (actual count) developing per culture were taken as the criteria by which the extent of growth could best be measured.

Unless otherwise specified all experiments were carried out in specially cleansed 300 ml. Erlenmeyer flasks, in each of which 50 ml. of the solution to be tested had been placed. The formulae of these solutions are given in connection with each experiment reported. Substances used in nutrient solutions were of the highest purity and all media were autoclaved at 15 pounds pressure for 15 minutes.

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[2] The organism is closely related to or identical with *Coprinus cubensis* Berk. & Curt. Its development has previously been described (Johnson, 1941).

Stock cultures were maintained on potato-dextrose agar and were allowed to produce mature sporophores. Fruit bodies produced in such cultures were removed, placed in a flask of sterile water, and rotated until a considerable number of spores were in suspension. The sporophores were then removed aseptically and the flask was shaken so as to maintain a uniform distribution of spores. Liquid media were inoculated by transferring 1 ml. of this spore dispersion to every 50 ml. of medium by means of a sterile pipette. After growth, the resulting cultures were filtered through alundum crucibles (RA360), the filtrate hastily washed with distilled water, and the dry weight of the mycelium produced was finally obtained. Solid media were inoculated with ½ cm. agar blocks, carefully cut from a Petri dish culture containing abundant and uniform mycelial growth. Hydrogen-ion concentrations were determined by Clark and Lub's indicator method, but in the experiments dealing with the effect of this factor on growth all values were checked with a Beckman glass electrode.

EXPERIMENTAL RESULTS

Periodicity of Fructification

When first isolated, the organism would fruit on potato-dextrose agar in nine days. Records were kept as to the regularity of fructification of all stock cultures, which were transferred at definite intervals, and on control cultures, which were grown on potato-dextrose agar each time an experiment was carried out. All these cultures were placed in a moderately lighted room at a temperature of $30 \pm 2°$ C. and maintained from September, 1936 to August, 1938, in Saint Louis, Missouri. During that period almost three-fourths of the cultures on potato-dextrose agar produced mature sporophores. When sporophores were produced they had always appeared by the ninth day after the inoculation of the culture, and in most cases the ninth day was the one upon which the first button of a culture expanded and began to deliquesce. Deliquesence of the first fruit body always occurred 9 ± 1 days after inoculation under the conditions mentioned above. Slight modifications could be obtained, either by placing the cultures in the dark or at a higher temperature during early stages of growth. Higher temperatures

for a day or two shortened, total darkness for a time lengthened the period required for fructification.

Elongation of the buttons into fruit bodies took place at equally interesting time intervals. Young buttons began to expand about 4:30 P.M. The peak in development was reached between midnight and 2:00 A.M., and deliquescence of the lamellae was usually completed by 8:00 A.M. of the day following the beginning of expansion. Cloudy days or the difference between day and night in winter and summer did not bring about variations greater than thirty minutes in the beginning of expansion, and conditions imposed by the writers did not modify it to a greater extent. The length of time required for total development seemed to depend upon the ultimate size of the organism, smaller plants usually maturing more rapidly than larger ones.

Effect of Temperature

Measurements of mean diameters of colonies of the fungus grown on potato-dextrose agar established an optimum temperature of 34 ± 1° C. In the same experiment all temperatures between 30–38° C. gave excellent growth. Since the thickness of *Coprinus* mycelium in such cultures varies a great deal, however, thallus dry-weight grown in liquid media has been considered a better measure of growth than mean colony diameter. Table I records the average dry weight of thallus produced five days after the inoculation of nutrient solutions containing 1 per cent peptone, ½ per cent beef-extract, and 2 per cent dextrose, at various temperatures.

Analysis of table I shows that no growth occurs at 10° or at 42° C.; that growth is fairly rapid at other temperatures between these limits and is exceptionally vigorous between 25–35° C. Under the conditions of our experiment 35 ± 1° C. is the optimum temperature for vegetative activity. The light factor involved made it difficult to test critically the temperature relation to fruit body production, but higher temperatures likewise favored abundant reproductive development. Cultures kept in rooms between 20–25° C. rarely fruited; cultures kept between 30–35° C. produced more fruit bodies per culture than did others kept between 25–30° C.

TABLE I

DRY WEIGHT OF THALLUS IN RELATION TO TEMPERATURE—*Coprinus*

Temperature ± 1° C.	No. of Flasks Inoculated	Initial pH	Final pH	Average Dry Weight (grams)
10	5	6.0	6.0	0.000
13	6	6.0	6.3	0.070
16	5	6.0	6.6	0.092
19	6	6.0	6.2	0.122
25	6	6.0	6.9	0.225
31	6	6.0	6.8	0.271
33	8	6.0	6.9	0.357
35	8	6.0	6.9	0.372
39	6	6.0	6.3	0.069
42	5	6.0	6.0	0.000

Effect of Hydrogen-ion Concentration

To test the influence of pH on the growth of this species of *Coprinus* potato-dextrose agar was prepared and titrated with acid or base to give a gradation of hydrogen-ion concentrations. Extremes were not compared because a pH greater than 9.2 or less than 4.0 would not buffer the sol. The medium was distributed in 100 ml. portions into 500 ml. Erlenmeyer flasks, sterilized, and checks tested after sterilization to obtain the initial pH value. The flasks were then inoculated with ½ cm. agar blocks containing vigorous mycelial growth and placed in an incubator (darkness) at 32 ± 1° C. At twelve hour intervals the extent, color, and type of mycelium were recorded. All media tested gave some growth, and media with initial pH values between 5.9 and 7.4 were favorable for rapid vegetative development. The optimum initial pH was 6.9. At initial pH 9.2 the mycelium was very shiny and closely pressed to the surface of the agar; all others were of a vigorous aerial type. After twenty-four hours all cultures were bright yellow in color. Cultures of high initial pH rapidly changed to a dark brown, those of lower initial pH became light brown and did not turn dark brown for five or six days. Because of variation in mycelial type and appearance the results obtained were checked by an experiment designed to measure the average dry weight of the mycelium produced after eight days growth in nutrient solutions of different hydrogen-ion concentrations. This is reported in table II.

TABLE II[3]

DRY WEIGHT OF THALLUS IN RELATION TO pH—*Coprinus*

Initial pH	No. of Flasks Inoculated	Final pH	Average Dry Weight (grams)
4.0	5	4.1	0.050
4.5	8	5.7	0.077
4.8	5	7.8	0.237
5.2	8	7.9	0.230
5.5	9	8.0	0.226
6.3	9	8.0	0.230
6.7	7	8.0	0.234
6.9	8	8.0	0.242
7.3	8	7.8	0.211
7.9	9	7.8	0.200
8.1	9	8.1	0.203

After nine days the flasks of potato-dextrose agar on which the mean colony diameter measurements had been made were brought into a well-lighted room at 30 ± 2° C. and allowed to produce mature sporophores. The first of these appeared after five additional days and production continued for a period of six days. Table III records the total number of sporophores produced at the different initial pH values of the cultures inoculated in this experiment.

TABLE III

Coprinus SPOROPHORE PRODUCTION IN RELATION TO pH

Initial pH	Final pH	No. of Normal Fruit Bodies	No. Undeveloped Fruit Bodies
4.0	6.6	16	75
5.0	6.9	10	31
5.9	7.2	18	37
6.9	7.9	23	26
7.5	7.7	13	56
8.2	8.6	10	55
9.2	8.9	13	57

All data indicate an initial pH of 6.9 as optimum both for vegetative growth and for the production of fruiting bodies. Initial pH values were changed by subsequent growth of the fungus, the pH always being raised except in the most extreme alkaline conditions

[3] The medium in this experiment consisted of 10.0 g. of dextrose and 10.0 g. of peptone per liter of distilled water. 0.1 N. H_2SO_4 and 0.1 N. NaOH were used for titrations. Solutions were prepared, autoclaved, and checks tested; the pH after sterilization was used without change to avoid a possible salt effect by the addition of both acid and base.

tested. Optimum growth was also obtained when final pH values were slightly alkaline. This species of *Coprinus* is not only tolerant to a wide range of hydrogen-ion concentrations (4.0–9.2), but in many cases it changes the pH of the substrate considerably during its growth.

Effect of Nitrogen Sources

The experiment recorded in table IV is designed to measure the dry weight of the mycelium produced after nine days growth (at $30 \pm 2°$ C.) in nutrient solutions containing different nitrogen sources. The control contained 10.0 g. dextrose, 0.75 g. $MgSO_4$, 1.25 g. KH_2PO_4, 0.25 g. KCl, 0.5 g. $CaNO_3$, a trace of $FeCl_3$, and 1000 ml. of distilled water. Nitrogen sources were added in amounts necessary to give the nitrogen equivalent of 20.0 g. of peptone per liter of solution.

TABLE IV[4]

DRY WEIGHT OF THALLUS IN RELATION TO NITROGEN SOURCES—*Coprinus*

Type of Culture	No. of Flasks Inoculated	Initial pH	Final pH	Average Dry Weight (grams)
Control	6	4.3	4.4	0.044
Tyrosine	3	4.4	4.4	0.049
Gelatine	6	4.7	4.8	0.050
$(NH_4)_2SO_4$	6	4.6	4.6	0.055
Alanine	6	4.6	4.6	0.057
Asparagine	6	4.6	4.6	0.057
Urea	6	6.8	6.8	0.064
$NaNO_3$	6	4.4	4.6	0.068
$NaNO_2$	5	6.5	6.5	0.072
Egg albumen	6	4.3	4.6	0.195
Casein	6	4.3	4.6	0.308
Peptone	6	4.3	5.0	0.326

[4] Media containing glycine and cystine were also tested. A slight amount of growth occurred in both; in fact, more than in the control. The initial pH values were so low, however, that they cannot be favorably compared with the other sources and hence they are omitted from the table. Some of the substances tested in this and other experiments were not completely soluble; in such cases all residue was left in the bottom of the culture flask. None of this material is included in the dry weight. The mycelial mat formed in these cultures was removed with forceps, placed in a flask of sterile water for washing, and finally filtered through alundum crucibles. It is possible that some weight was lost in this process, but the greatest possible precautions were taken to prevent error here.

Table V records measurements similar to those of table IV, but in this experiment all mineral nutrients were omitted and the control consisted of 10.0 g. of dextrose and one liter of distilled water. The nitrogen sources were added in the same ratio as in the previous case and the cultures were kept at the same temperature. No growth was obtained in the control or in the following: glycine, tyrosine, gelatine, cystine, $(NH_4)_2SO_4$, asparagine, $NaNO_3$, and $NaNO_2$. Since flasks containing glycine and cystine showed a very low pH, either this factor or the lack of availability of the substances for food may be the reason for lack of growth in them. The pH could not have been the important factor with the other cultures.

TABLE V

DRY WEIGHT OF THALLUS IN RELATION TO NITROGEN SOURCES—*Coprinus*

Type of Culture	No. of Flasks Inoculated	Initial pH	Final pH	Average Dry Weight (grams)
Urea	6	8.3	8.0	0.027
Alanine	6	4.6	4.7	0.036
Egg albumen	6	6.1	6.6	0.075
Casein	9	4.4	5.0	0.108
Peptone	9	6.2	7.3	0.119

Far better results were obtained with complex protein materials (egg albumen, casein, and peptone). The presence of minerals (compare tables IV and V) increased growth to a significant extent.

Effect of Carbohydrate Sources

Table VI records measurements of the effect of various carbohydrate sources on the dry weight of mycelium produced after nine days (at 30 ± 2° C.) in nutrient solutions. The control contained 10.0 g. of peptone to each liter of distilled water. Carbon sources were added in the amounts necessary to give the carbon equivalent of 20.0 g. of dextrose per liter of solution.

Miscellaneous Remarks

Attempts were made to test the effect of minerals upon growth, using media containing several mineral nutrients and intermediate

conditions lacking single ions. Solutions without ions gave no growth and complete solutions the most growth, but solutions lacking ions gave results difficult to interpret.

The species studied may be an unusual *Coprinus,* for it did not grow on horse dung. Spores did not produce visible mycelium on this substrate and inoculations from agar blocks with vigorous

TABLE VI

DRY WEIGHT OF THALLUS IN RELATION TO CARBOHYDRATE SOURCES—*Coprinus*

Type of Culture	No. of Flasks Inoculated	Initial pH	Final pH	Average Dry Weight (grams)
Control	9	6.7	8.1	0.067
Amygdalin	9	6.6	7.2	0.076
Xylose	8	3.8	7.5	0.105
Arabinose	9	4.6	7.9	0.112
Lactose	7	6.3	7.2	0.144
d-Galactose	7	5.9	7.9	0.153
Inulin	9	6.8	8.1	0.155
Sucrose	8	6.6	8.1	0.166
Raffinose	7	6.0	8.3	0.192
Dextrose	9	6.1	7.7	0.200
Maltose	9	6.4	8.0	0.210
Levulose	7	5.4	7.5	0.215
Mannitol	8	6.8	8.1	0.221
Starch	8	6.6	7.6	0.224
Dextrin	9	6.8	7.8	0.240
Mannose	8	6.0	7.5	0.255

mycelial growth simply sent from the agar into the air aerial hyphae typical of old cultures. Flask cultures on horse dung did not change appearance, but the cultures on potato-dextrose agar, kept under the same conditions, produced an abundance of fruiting bodies. Experimental conditions were not sufficiently varied, however, to assure that similar results would always occur.

DISCUSSION

There is little in mycological literature with regard to the conditions under which fruit bodies of mushrooms are produced in culture. The extreme regularity of fructification of the species studied by the writers has made it possible to present data of this kind in connection with conditions of temperature and hydrogen-

ion concentration. Optimum vegetative growth in a closed system favored quick and abundant reproductive development.

An exceptionally high temperature is indicated as optimum for mycelial growth and for the production of sporophores. Does this hold only in the laboratory, or is this indicative of the tropical habit of the organism? Optimum temperatures of species of the temperate zone are known in only a few cases; it is possible that the rarity with which temperate forms fruit in culture is due to the fact that the organisms need a temperature for that process considerably above that of the ordinary room in which preliminary experiments are usually carried out (20–22° C.).

Cultures of the fungus studied did not appear to differ in vigor at the end of two years from the cultures, freshly isolated. After four years, however, certain characteristics of the organism may have changed. The morphological characters of the fruit body have not yet altered, but the rate of growth and the percentage of cultures producing sporophores are not quite the same.

SUMMARY AND CONCLUSIONS

1. This paper contains data derived during the culture of a species of *Coprinus* (closely related to or identical with *C. cubensis* Berk. & Curt.).

2. The fungus requires an exceptionally high temperature for its optimum vegetative development (35° C.) and for the production of sporophores.

3. Regularity of fructification in culture is well established. Even under somewhat variable conditions, sporophores produced on potato-dextrose agar appeared in 9 ± 1 days.

4. Development of the fruit body is correlated with periods of the day. Young buttons begin to expand about 4:30 P.M.; the sporophores reach maturity in the early morning and old age in the late morning of the following day.

5. In nutrient solution and on potato-dextrose agar the optimum initial pH for this *Coprinus* is 6.9. It often greatly changes initial pH values, usually to a more alkaline condition, and optimum fruiting takes place at a final pH of 7.9. Extreme acid pH values are changed to less acid or to alkaline ones, while alkaline conditions

usually remain unchanged or are changed to still more alkaline ones (although some of the most alkaline have been slightly lowered) during growth.

6. The fungus does not effectively utilize nitrogen when it is applied alone, or with a carbon source (dextrose), in the form of amino-acids, urea, gelatine, or inorganic ammonium, nitrate, or nitrite salts. Better results are obtained, however, with complex protein materials.

7. When applied with a nitrogen source (peptone) the fungus showed little specificity for carbohydrate groups, although the glucoside and pentose were least efficient.

8. Failure to grow on horse dung is a striking characteristic indicating that this may be a most unusual species of *Coprinus*.

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MORE FLORIDA NOVELTIES[1]

WILLIAM A. MURRILL

Venenarius alliaceus sp. nov.

Pileo convexo, 8 cm. lato, albo, odore alliaceo; sporis 13 × 4 μ; stipite albo, floccoso, bulboso, 10 × 1.5–2.5 cm.

Pileus convex, about 8 cm. broad; surface white, smooth, shining, decorated with a few volval fragments, margin entire, even, appendiculate; context thin, white, unchanging, with a pronounced garlic odor; lamellae adnate, narrow, rather close, unequal, entire, white; spores sausage-shaped, smooth, hyaline, about 13 × 4 μ; stipe tapering upward, floccose, solid, white, 10 × 1.5–2.5 cm.; bulb enormous, ovoid or slightly truncate, radicate, about 4 × 3.5 cm.; volva limb 2 cm. high, partly carried aloft and the remainder collapsed against the stipe; veil thin, membranous, white, becoming more or less torn, but leaving an annulus at the apex.

Type collected under a live-oak at the Tung-oil Mill on the Newberry Road, west of Gainesville, Fla., June 18, 1938 (No. *F 16418*). A very handsome species strongly suggesting *Amanita cylindrispora* Beardslee, but having a decided odor of wild onions and being entirely distinct from *A. roanokensis* Coker, which Beardslee says is the same as his species.

Venenarius praelongisporus sp. nov.

Pileo convexo-plano, 7 cm. lato, glabro, albido, odore nullo; sporis elongatis, glabris, 9–13 × 3–4 μ; stipite pallido, 6–8 cm. longo; volva magna, alba, cupuliformi.

Pileus convex to expanded, gregarious, about 7 cm. broad; surface dry, smooth, glabrous, white or with a faint cream tint, margin even, entire; context white, without odor; lamellae adnate, narrow, close, white, becoming brownish with age or on drying, the edges remaining white; spores cylindric or oblong-ellipsoid, smooth, hyaline, 9–13 × 3–4 μ; cystidia none; stipe equal, white with a yellowish tint, squamulose above, about 6–8 cm. long and 8–12 mm. thick;

[1] The specimens cited in this paper are deposited in the Herbarium of the Florida Agricultural Experiment Station, at Gainesville.

bulb abrupt, short-radicate, about 1.5 cm. high and wide; volva flaring, white, with free limb; veil ample, white, either forming an apical annulus or becoming torn into large fragments.

Type collected by W. A. Murrill in bare soil under a live-oak in Gainesville, Fla., May 16, 1938 (No. *F 16108*). Also collected by the author under a pine in Gainesville, Aug. 23, 1937 (*F 15926*). This species differs from *V. roanokensis* Coker in being free from the odor of chloride of lime and in having no volval fragments on its cap. At first sight it suggested to me *Venenarius virosus* of Fries.

Venenarius solitariiformis sp. nov.

Pileo convexo-subexpanso, 6–8 cm. lato, albido, gemmato; sporis elongatis, 10–13 × 4–5 μ; stipite tomentoso, albo, 3–4 × 1.3–1.5 cm.; volva veloque evanescentibus.

Pileus convex to subexpanded, solitary, 6–8 cm. broad; surface dry, white stained with cream, decorated with conspicuous, sharp, gemmate warts, especially on the disk, margin even, entire; context white, without any odor of chloride of lime; lamellae just free, not rounded behind, arcuate, medium broad and medium distant, white to isabelline with white edges, few short ones; spores elongate, smooth, hyaline, granular, 10–13 × 4–5 μ; stipe short, white, floccose-tomentose, tapering upward, 3–4 × 1.3–1.5 cm.; bulb ovoid, radicate, white, without volval limb; veil evanescent, remaining in fragments on margin and stipe but forming no annulus.

Type collected by W. A. Murrill under an oak in Gainesville, Fla., Aug. 9, 1937 (No. *F 16415*). Also collected by the author under a pine in Gainesville, June 22, 1938 (*F 16515*). Resembling *V. solitarius* but having elongate spores.

Venenarius subsolitarius sp. nov.

Pileo convexo-expanso, 5–8 cm. lato, albo vel roseo-isabellino; lamellis adnatis, albis, sporis 10–12 × 4–6 μ; stipite albo, floccoso, volva et velo fragilibus.

Pileus convex to expanded, scattered, gregarious or cespitose, 5–8 cm. broad; surface dry, white or rosy-isabelline, decorated with small pointed warts and floccose scales, margin even, appendiculate; context thin, white, odorless; lamellae adnate, rather close, narrow, white, fimbriate; spores subcylindric, smooth, hyaline, about

10–12 × 4–6 μ; stipe slender, tapering upward, enlarged and radicate below, white, floccose, 5–10 × 1–1.5 cm.; volva and veil wholly friable.

Type collected by W. A. Murrill in mixed oak and pine woods at Gainesville, Fla., June 1, 1938 (No. *F 16449*). Also collected here by the author three other times under pine and once under oak (*F 16405, F 16462, F 16450, F 16482*). The spores are too elongate for *V. solitarius* and the gills too white for *V. praelongisporus*.

Venenarius virosiformis sp. nov.

Pileo convexo-plano, 6–8 cm. lato, glabro, albo, non striato; lamellis adnatis, sporis elongatis, 12 × 6 μ; stipite albo, bulboso, 8–9 × 1–1.5 cm., annulo amplo, volva magna.

Pileus convex to plane, solitary, 6–8 cm. broad; surface slightly viscid when wet, smooth, glabrous, white, margin even, entire; context thin, white, unchanging, with a distinct odor of chloride of lime; lamellae adnate, decurrent to the annulus in 1–3 raised lines, unequal, rather narrow, close or medium close, white, the edges fimbriate, finely serrate or much eroded; spores oblong-ellipsoid, smooth, white, with granular contents, about 12 × 6 μ; basidia very large and granular; cystidia none; stipe equal above the bulb or slightly tapering upward, smooth, glabrous, white, 8–9 × 1–1.5 cm.; bulb subglobose, white, not radicate, about 2.5 cm. wide and high; volva limb either spreading or collapsed, lobed or ragged, 1–1.5 cm. high; annulus 1–2 cm. from the apex, simple, membranous, ample, persistent, white.

Type collected by W. A. Murrill under a live-oak in Gainesville, Fla., May 26, 1938 (No. *F 16229*). Also collected by the author on a spaded lawn in Gainesville, May 25, 1938 (*F 16253*). Suggesting *Amanita virosa* Fries, but having elongate spores and the odor of chloride of lime. From *A. Gwyniana* Coker the spores and adnate gills distinguish it.

Venenarius fraternus sp. nov.

Pileo convexo-expanso, 2–4 cm. lato, viscido, melleo, disco subfuligineo; lamellis albis, sporis 6 × 4.5 μ; stipite roseo-isabellino, floccoso, 6–7 cm. longo, annulo albo, persistente.

Pileus convex to expanded, closely gregarious, 2–4 cm. broad; surface viscid, with few volval fragments, not striate, dull melleous with subfuliginous disk; context thin, white; lamellae free, broad,

crowded, white, the edges fimbriate; spores ovoid, smooth, hyaline, about 6 × 4.5 μ; stipe slender, equal above the small bulb, whitish-floccose, rosy-isabelline throughout, 6–7 × 0.5–0.8 cm.; volva fragile; annulus superior, about 2 cm. from the apex, white, membranous, persistent.

Type collected by W. A. Murrill under a laurel oak in Gainesville, Fla., June 7, 1938 (No. *F 16376*). Also collected by the author under an oak in Gainesville, June 8, 1938 (*F 16377*). Growing close together in small groups of three or four hymenophores. Much smaller than *V. flavorubescens* (Atk.) Murr., neither gibbous nor striate, and the stipe rosy-isabelline throughout.

Venenarius gemmatus volvatus var. nov.

Pileo glabro, striato; sporis 10–12 × 6–8 μ; volva lobata, 2 cm.; annulo magno, persistente.

Pileus convex to nearly plane, solitary, about 8 cm. broad; surface glabrous, without volval fragments, cremeous, dark isabelline on the disk, margin almost white, entire, distinctly striate for 1–2 cm.; lamellae adnexed, unequal, crowded, entire, white and drying white; spores ovoid, smooth, hyaline, granular, 10–12 × 6–8 μ; stipe tapering upward, smooth, white, floccose above and subglabrous below, about 12–16 cm. long and 6–10 mm. thick; bulb ovoid, white, 3 cm. high and 2.5 cm. thick; volva limb lobed, about 2 cm. high, flaring or collapsed; annulus large, membranous, white, persistent, fixed about 3 cm. from the apex.

Type collected by W. A. Murrill under a live-oak in Gainesville, Fla., May 28, 1938 (No. *F 16224*). Also collected by the author in oak-pine woods near Gainesville, May 29, 1938 (*F 16216*).

This is quite distinct from the northern plants I have seen in having a large volva similar to that of *A. verna* with no patches on the cap. This was true of at least twenty-five hymenophores picked during one afternoon in a woodland near Gainesville. Only one specimen of the typical form of *A. gemmata* had been found at that time but it appeared in abundance two weeks later under evergreen oaks, exhibiting all the variations so characteristic of the species.

Venenarius suballiaceus sp. nov.

Pileo convexo-expanso, 3–4 cm. lato, albo; lamellis liberis, sporis globosis, 6 μ; stipite albo, 9 × 0.5–1 cm., annulo albo, persistente.

Pileus convex to expanded, scattered, 3–4 cm. broad; surface slightly viscid, smooth, white, glabrous, margin even, entire; context thin, white, unchanging, with a strong garlic odor; lamellae just free, without connecting ridges, close, entire, white, unchanging; spores globose or subglobose, smooth, hyaline, apiculate, granular, about 6 μ; stipe subequal above the deeply buried bulb, slender, subglabrous, smooth, white, 9 $\times$ 0.5–1 cm.; bulb ellipsoid, volva limb lobed; annulus white, membranous, thin, weak, attached at the very apex or near it and hanging like a wet skirt.

Type collected by W. A. Murrill in mixed woods of live-oak and loblolly pine at Gainesville, Fla., June 22, 1938 (No. *F 16495*). Suggesting *A. verna* but having smaller spores and a strong garlic odor, which persists for a time at least in the dried specimens. In *A. alliacea* the spores are elongate.

Lepiota subfulvastra sp. nov.

Pileo convexo, umbonato, caespitoso, 1–1.5 cm. lato, latericio-squamuloso; lamellis albis, sporis 6–7 $\times$ 3–4 μ; stipite bulboso, 1.5 cm. longo, annulo persistente.

Pileus convex, umbonate, cespitose or gregarious, 1–1.5 cm. broad; surface dry, pallid, squamulose, the scales and umbo latericious, margin entire, not at all striate; context membranous, pallid, unchanging; lamellae free, attached to a collar, ventricose, medium distant, unequal, entire, white, unchanging; spores ellipsoid, smooth, hyaline, 6–7 $\times$ 3–4 μ; stipe equal above the small bulb, subglabrous, smooth, pallid, or pale latericious, especially below, 1.5 $\times$ 0.1 cm.; annulus superior, membranous, white above, rosy-isabelline below.

Type collected by W. A. Murrill on an exposed bank in Gainesville, Fla., June 6, 1938 (*F 16446*). Very pretty with its small red umbo and reddish scales, usually growing in clusters of three or four hymenophores.

Lepiota subrhodopepla sp. nov.

Pileo expanso, 3–4 cm. lato, striato, squamuloso, albo, disco isabellino; lamellis liberis, albis, rubescentibus; sporis 5–6 $\times$ 4–5 μ; stipite glabro, albo, rubescente, 3–6 cm. longo; annulo albo, rubescente.

Pileus convex to expanded, not umbonate, solitary, 3–4 cm. broad; surface long-striate, dry, squamulose, white, isabelline on the disk, becoming pink about the margin on drying; context thin, white, pink when dry; lamellae free, narrow, crowded, white, pink

when dry, whitish-fimbriate on the edges; spores subglobose to broadly-ellipsoid, smooth, hyaline, uniguttulate, 5–6 × 4–5 μ; cystidia none; stipe long, slender, tapering upward from an abruptly bulbous base, smooth, glabrous, white, dark-pink when dry, 3–6 × 0.3–0.4 cm.; annulus median, membranous, persistent, loosely attached, white, changing to pink on drying.

Type collected by W. A. Murrill on a lawn in Gainesville, Fla., June 1, 1938 (No. *F 16235*). Also collected by the author on a lawn in Gainesville, June 3, 1938 (*F 16375*). Suggesting *Lepiota rhodopepla* Morgan but having narrow, crowded gills and shorter spores. The color of the dried gills is a beautiful dark-roseous shade.

Gymnopus subagricola sp. nov.

Pileo convexo, 1 cm. lato, isabellino, glabro; lamellis adnatis, pallidis; stipite glabro, 2–3 × 0.1–0.2 cm.

Pileus regularly convex, not fully expanding, gregarious, scarcely 1 cm. broad; surface dry, smooth, glabrous, isabelline or pale rosy-isabelline, margin even, entire, becoming hygrophanous and discolored; context thin, discolored under the cuticle, pallid below, with pleasant odor and mawkish flavor, becoming slightly astringent; lamellae adnate with decurrent tooth, subdistant, unequal, broad, entire, pallid to discolored; spores smooth, hyaline, scarce, 3–4 μ long; stipe enlarged and white at the apex, subequal and rosy-isabelline below, smooth, glabrous, 2–3 × 0.1–0.2 cm.

Type collected by W. A. Murrill on a road through oak woods in Gainesville, Fla., June 24, 1938 (No. *F 16323*). One of the inconspicuous things that most persons would overlook or ignore.

Gymnopus Tricholoma sp. nov.

Pileo convexo-depresso, 1 cm. lato, tomentosulo, albido, disco isabellino; lamellis sinuatis, subdistantibus, sporis ellipsoideis, 6–7 × 4–5 μ; stipite albo, cartilagineo, 1.5–2 × 0.2–0.3 cm.

Pileus convex to depressed, gregarious, 1 cm. or less broad; surface minutely tomentose, dry, smooth, pallid, isabelline on the disk, margin even, entire; context thin, white, odorless; lamellae sinuate, rather distant, broad, equal, entire, pallid; spores ellipsoid, inequilateral, smooth, hyaline, 6–7 × 4–5 μ; stipe tapering upward, compressed, smooth, finely fibrillose, white, cartilaginous, 1.5–2 × 0.2–0.3 cm.

Type collected by W. A. Murrill under a pine in Gainesville, Fla., June 7, 1938 (No. *F 16386*). Suggesting *Tricholoma* but having a cartilaginous stem.

Hydrocybe foliirubens sp. nov.

Pileo conico, 1–1.5 cm. lato, purpureo-rubro; lamellis ochroleucis, rubescentibus, sporis 8–10 × 4 μ; stipite rubro et flavo, 3–4 × 0.1–0.15 cm.

Pileus conic, gregarious, 1–1.5 cm. broad; surface dry, smooth, glabrous, purplish-ruber, more or less blackish-chestnut on drying, margin entire, even; context very thin, odorless; lamellae distant, equal, narrow behind, very broad at the tip, entire, ochroleucous, becoming miniatous on drying; spores elongate, obliquely apiculate, uniguttulate, smooth, hyaline, 8–10 × 4 μ; stipe very slender, equal, smooth, glabrous, red above, yellow below, slightly greenish at the very base, 3–4 × 0.1–0.15 cm.

Type collected by W. A. Murrill on a lawn under an oak in Gainesville, Fla., June 8, 1938 (No. *F 16432*). Resembling *H. conica* in shape but much smaller and the gills turn red instead of black. A beautiful, dainty species without any near relatives in this country.

Omphalina floridana sp. nov.

Pileo convexo-depresso, umbilicato, 8–13 mm. lato, albo, glabro; lamellis distantibus; sporis 5 × 3 μ; stipite albo, glabro, 1–1.2 × 0.1–0.2 cm.

Pileus convex to depressed, umbilicate, gregarious, 8–13 cm. broad; surface somewhat uneven, glabrous, white, margin even, entire, incurved when young; context very thin, white, unchanging, fleshy, decidedly farinaceous in odor and taste; lamellae strongly decurrent, white, narrow, inserted, distant, none forked, edges thin, entire; spores ellipsoid, smoth, hyaline, about 5 × 3 μ; stipe equal or subequal, cartilaginous, smooth, glabrous, white, 1–1.2 cm. long, 1–2 mm. thick.

Type collected by W. A. Murrill on open bare ground in Gainesville, Fla., May 31, 1938 (No. *F 16223*). Suggesting at first sight a tiny *Clitocybe dealbata*. Several score of the little white hymenophores were found after a heavy rain.

Lactaria arcuata sp. nov.

Pileo convexo-depresso, 6 cm. lato, albo, glabro; lamellis albis, arcuatis, lacte alba, piperata; sporis verruculosis, subglobosis, 4–6 μ longis; stipite albo, breve, 2.5 × 1.5 cm.

Pileus convex to depressed, solitary, 6 cm. broad; surface slightly viscid when moist, rough, glabrous, white, margin entire, even, thin, soft, involute; context and latex white, unchanging, moderately acrid at once, at length bitter; lamellae adnate or slightly decurrent, narrow, strongly arched, rather close, a few forked and a few inserted, white, unchanging, edges mostly entire; spores subglobose, verruculose, white, 4–6 μ long; stipe very short, subglabrous, white, unchanging, equal, 2.5 $\times$ 1.5 cm.

Type collected by W. A. Murrill under a laurel oak in Gainesville, Fla., June 15, 1938 (No. *F 16366*). White throughout, even when dried. Gills finely arched; spores much smaller than in most of our white species.

Russula subalbidula sp. nov.

Pileo convexo-depresso, 6–10 cm. lato, glabro, albo, disco cremeo, sapore piperato; sporis globosis vel subglobosis, cremeo-albis, 6–8 μ longis; stipite albo, glabro, 4 $\times$ 1.5–2 cm.

Pileus convex to plane or somewhat depressed, not umbonate, gregarious, 6–10 cm. broad; surface smooth, glabrous, slightly viscid when moist, white with cremeous center, entirely cremeous in age or on drying, pellicle not separable, margin entire, rarely striate; context firm, white, odorless, soon rather acrid; lamellae rather narrow, crowded, equal, adnexed, entire, milk-white, becoming dingy yellowish-white with age; spores globose or subglobose, closely and conspicuously echinulate, creamy-white, 6–8 μ long; stipe tapering upward or sometimes equal, short, smooth, glabrous, milk-white, 4 $\times$ 1.5–2 cm.

Type collected by W. A. Murrill on a lawn under laurel oaks in Gainesville, June 4, 1938 (No. *F 16403*). Abundant under evergreen oaks in Gainesville early in June, 1938, and collected several times by the author. Its color and acrid taste at first suggested *R. albidula,* which grows commonly under pines and cedars, but it differs in shape, spore characters, habitat, taste, the color of the disk, and the adnate pellicle. Sterile cells are abundant on the edges of the gills, projecting about 30 μ.

Russula subdensifolia sp. nov.

Pileo convexo-depresso, 7 cm. lato, glabro, cremeo, tuberculato-striato, subnigricante, sapore grato; sporis albis, spinulosis, 6–7 μ longis; stipite glabro, albo ad cinereo, 7 $\times$ 1.5–2 cm.

Pileus convex to depressed, solitary, 7 cm. broad; surface slightly viscid when wet, glabrous, cremeous, margin entire, widely tuberculate-striate; context thin, white, mild, odorless; lamellae adnate, rather close, of medium width, mostly equal, entire, pallid; spores subglobose, spinulose, hyaline, 6–7 μ long; cystidia none; stipe subequal, smooth, glabrous, milk-white, 7 × 1.5–2 cm. On drying the surface of the pileus becomes pale umbrinous, while the lamellae and stipe become cinereous.

Type collected by W. A. Murrill under a live-oak in Gainesville, Fla., June 1, 1938 (*F 16447*). This species has characters in common with *R. decolorans* and also with the group to which *R. densifolia* belongs. The spores are conspicuously spinulose. One is hardly prepared for the entire change in color on drying.

Russula subincarnata sp. nov.

Pileo convexo-depresso, 5 cm. lato, viscido, striato, incarnato, sapore grato; lamellis distantibus, sporis stramineis, globosis, echinulatis, 7–8 μ; stipite roseo, 3 × 1 cm.

Pileus convex to slightly depressed, solitary, 5 cm. broad; surface slightly viscid, glabrous, coarsely and conspicuously striate, peeling readily, uniformly dull incarnate, margin entire; context thin, sweet, white, rosy under the cuticle; lamellae adnate or slightly decurrent, equal, a few forked, broad, distant, entire, white to stramineous; spores stramineous in mass, globose, strongly echinulate, 7–8 μ; stipe subequal, smooth, glabrous, roseous, 3 × 1 cm.

Type collected by W. A. Murrill under a pine in Gainesville, Fla., June 8, 1938 (No. *F 16448*). A rare species of unusual appearance, with its red, striate cap, rosy stem, and distant gills.

Russula subflava sp. nov.

Pileo convexo-expanso, 6 cm. lato, glabro, viscido, ochroleuco, margine striato; sapore grato; sporis albis, globosis, 6 μ; stipite albo, glabro, 6–7 × 1–2 cm.

Pileus convex to slightly depressed, gregarious, about 5–6 cm. broad; surface smooth, glabrous, viscid when wet, peeling readily, uniformly ochroleucous; margin entire, striate for 5 mm. or more; context white, unchanging, mild, odorless; lamellae adnexed, rather close, narrow, half of them forked at the base, very few inserted, white with a pale-yellowish tint; spores white, globose, echinulate

about 6 μ; cystidia none; stipe smooth, glabrous, milk-white, stuffed, 6–7 $\times$ 1–2 cm.

Type collected by W. A. Murrill under a live-oak in Gainesville, Fla., May 30, 1938 (No. *F 16256*). Suggesting the somewhat mythical *R. flava* Romell but differing in several ways. A pretty plant when fresh, with its pale-yellow cap and pure-white stem, but the colors fade a little on drying.

Russula Westii sp. nov.

Pileo convexo-depresso, 3–4 cm. lato, glabro, albo, sapore grato; sporis cremeis, 7 $\times$ 5 μ; stipite albo, glabro, 2–2.5 $\times$ 1–1.5 cm.

Pileus convex to depressed at the center, gregarious, 3–4 cm. broad; surface slightly viscid, smooth, glabrous, uniformly white, pale yellowish when dry, cuticle adnate, margin entire, even; context firm, rather thick, sweet and nutty, odorless, white, unchanging; lamellae white, adnate, medium broad, close, entire, many forked at the base; spores cremeous in mass, broadly ellipsoid, minutely verrucose, uniguttulate, 7 $\times$ 5 μ; stipe short, equal or subequal, smooth, glabrous, white, unchanging, stuffed, about 2–2.5 $\times$ 1–1.5 cm.

Type collected by Erdman West under an oak in Gainesville, Fla., June 9, 1938 (No. *F 16404*). A small, neat species, white throughout but with cremeous spores. The flavor is sweet and nutty without any later unpleasantness. Mr. West examined the spores for me under high magnification. They are unusual for the genus.

Entoloma alachuanum sp. nov.

Pileo convexo-expanso, cespitoso, 2.5 cm. lato, umbrino, striato, sapore farinaceo; sporis valde angulatis, 7–8 μ, stipite glabro, pallidiore, 3–4 $\times$ 0.2–0.3 cm.

Pileus convex to expanded, papillate, cespitose, about 2.5 cm. broad, surface glabrous, umbrinous with fuliginous umbo, margin entire, striate; context thin, white or pallid, odorless but with strongly farinaceous taste; lamellae sinuate or adnate with decurrent tooth, unequal, rather distant, of medium width, entire, pallid to dark-pink; spores decidedly angular, apiculate, usually 1–2 guttulate, pink, 7–8 μ in diameter; stipe fleshy, equal, smooth, glabrous, shining, pale avellaneous or pale fumose, 3–4 $\times$ 0.2–0.3 cm.

Type collected by W. A. Murrill in an open pasture south of Gainesville, Fla., June 3, 1938 (No. *F 16509*). A small, dark, clustered species with a decidedly farinaceous flavor. The spores are beautifully polygonal, about as broad as long, with a prominent apiculus.

Entoloma pernivosum sp. nov.

Pileo convexo-expanso, albo, subglabro, non striato, 1.5–2 cm. lato; sporis angulatis, pallidis, 8 × 5 μ; cystidiis 35–45 × 10–15 μ, fusoideo-ventricosis apice lobatis; stipite glabro, albo, subbulboso, 3 × 0.3–0.5 cm.

Hymenophore snow-white throughout; pileus convex to expanded, not umbonate, gregarious, about 1.5–2 cm. broad; surface uneven, not striate, very slightly innate-fibrillose, margin entire; context thin, without odor or taste; lamellae adnate or adnexed, unequal, rather narrow, medium close, entire; spores ellipsoid in outline, angular, uniguttulate, very pale, about 8 × 5 μ; cystidia flask-shaped, capitate, with lobed apex, abundant, about 35–45 × 10–15 μ; stipe smooth, glabrous, equal above the slightly enlarged base, about 3 × 0.3–0.5 cm.

Type collected by W. A. Murrill on a lawn in Gainesville, Fla., May 26, 1938 (*F 16220*). A white species without close relatives. The cystidia suggest ovaries with sessile, lobed stigmas.

Pluteus citrinus sp. nov.

Pileo convexo, umbonato, squamuloso, citrino, 5 cm. lato; sporis subglobosis, 5–6 μ, cystidiis 30 × 12 μ; stipite glabro, cremeo, 4 × 0.5–0.8 cm.

Pileus convex to subexpanded, solitary, 5 cm. broad; surface dry, slightly innate-fibrillose, citrinous, finely squamulose and isabelline-flavous on the low, broad umbo; margin even, entire, concolorous; context firm, white, unchanging, taste nutty; lamellae free, rounded behind, rather broad, medium close, 2–3 times inserted, entire, soon rose-colored; spores broadly ellipsoid or subglobose, smooth, pink, 5–6 μ long; cystidia tapering from a swollen base, hyaline, pointed, abundant, about 30 × 12 μ; stipe enlarged above and below, glabrous, slightly striate, solid, cremeous, 4 × 0.5–0.8 cm.

Type collected by W. A. Murrill on an oak log at Magnesia Springs, Alachua Co., Fla., May 22, 1938 (No. *F 16251*). A strikingly beautiful species related to *P. leoninus* (Schaeff.) Quél. but with smaller spores and the margin not at all striate.

Galerula caespitosa sp. nov.

Pileo semiglobato, caespitoso, 1.5 cm. lato, micaceo, striato; sporis ellipsoideis, 11–13 × 6–7 μ; stipite albo, glabro, 2–4 × 0.1–0.3 cm.

Pileus hemispheric, not fully expanding, strictly cespitose, 1.5 cm. broad; surface dry, pulverulent, glistening like mica, long-striate, uniformly pale rosy-isabelline or avellaneous, margin entire; context very thin, pallid; lamellae squarely adnate, narrow, crowded, unequal, pallid to fulvous, whitish on the edges; spores ellipsoid, smooth, yellowish-brown, 11–13 × 6–7 μ; stipe slender, equal, smooth, glabrous, white, 2–4 × 0.1–0.3 cm.

Type collected by W. A. Murrill under an oak in Gainesville, Fla., May 29, 1938 (No. *F 16389*). Also collected by the author on a chip in a sawdust pile in Gainesville, June 1, 1938 (*F 16437*). Near *G. Kellermani* (Peck) Murr. but definitely cespitose and having longer spores.

Galerula floridana sp. nov.

Pileo conico-subexpanso, 2–5 cm. broad, isabellino, glabro; sporis ovoideis vel ellipsoideis, 8–9 × 6–7 μ; stipite longo, radicato, pallido, 7–10 × 0.1–0.3 cm.

Pileus conic to subexpanded, solitary, 2–5 cm. broad; surface dry, smooth, glabrous, uniformly isabelline, margin entire, even, upturned with age; context thin, pallid, odorless; lamellae adnate or adnexed, narrow, close, unequal, entire, soon becoming pale fulvous; spores ovoid or ellipsoid, truncate, smooth, yellowish-brown, uniguttulate, 8–9 × 6–7 μ; stipe long, slender, equal, smooth, glabrous, long-radicate, pallid, 7–10 × 0.1–0.3 cm.

Type collected by W. A. Murrill in sandy soil under trees in Sugarfoot Hammock, near Gainesville, Fla., June 5, 1938 (No. *F 16435*). Also collected by the author in oak woods at Gainesville, June 3, 1938 (*F 16387*). This species has the typical *Galera* form when young but in age assumes the shape of a hat with high crown and upturned brim. The stem is long-radicate as in *Collybia radicata.*

Drosophila floridana sp. nov.

Pileo convexo-subexpanso, fulvo, tomentosulo, 1–1.5 cm. lato, margine appendiculato; lamellis adnatis; sporis 7 × 5 μ; stipite 2 × 0.2–0.4 cm.

Pileus hemispheric to broadly convex, not fully expanding, not umbonate, gregarious, 1–1.5 cm. broad; surface hygrophanous, not viscid, smooth, tomentulose, uniformly fulvous; margin conspicuously appendiculate with a white fringe; context thick, white, unchanging, sweet, nutty; hymenium plane, pallid, soon becoming purplish; lamellae broadly adnate with a slight notch, several times inserted, medium close, quite broad, the edges densely fringed with long, pointed, hyaline, sterile cells; spores ellipsoid, smooth, dark purplish-brown, about $7 \times 5\ \mu$; stipe equal or subequal, smooth, glabrous and white above, floccose and yellowish below, fistulose, pallid within, about 2×0.2–0.4 cm.

Type collected by W. A. Murrill on open bare ground in Gainesville, Fla., May 31, 1938 (No. *F 16227*). A small, shapely species with a conspicuous white fringe on the margin of a fulvous cap. In very young stages the white veil is continuous but it soon breaks up into small fragments. In older stages the marginal zone may become ochraceous while the disk remains fulvous.

Stropharia bilamellata tomentosa var. nov.

Pileo isabellino, tomentoso; sporis 6–8×4–$5\ \mu$.

Pileus convex to hemispheric, solitary, 4 cm. broad; surface smooth, dark isabelline, densely tomentose; context thick, isabelline, mild; lamellae sinuate; spores ovoid or ellipsoid, 6–8×4–$5\ \mu$; stipe stout, 1.3 cm. thick.

Type collected by W. A. Murrill under an oak in Gainesville, Fla., May 28, 1938 (No. *F 16230*). Very different from the typical smooth, white or pale-yellowish form so common on southern lawns.

Agaricus pocillator sp. nov.

Pileo convexo-expanso, 7–10 cm. lato, albo, squamuloso, disco umbrino; sporis ovoideis, 4–$5 \times 3\ \mu$; stipite albo, 6–8×0.6–0.8 cm.

Pileus truncate-convex to plane, gregarious or subcespitose, 7–10 cm. broad; surface dry, smooth, white, decorated with minute, dark, floccose scales, fuscous on the disk; context thin, white, unchanging, sweet, edible; lamellae close, rather narrow, white, turning pink and finally blackish-brown; spores ellipsoid, smooth, purplish-brown, about 4–$5 \times 3\ \mu$; stipe slender, 6–8×0.6–0.8 cm., smooth, subglabrous, white, enlarged at the base, usually in the

form of a shallow cup about 1.5 cm. broad and 4 mm. high; annulus apical, membranous, ample, persistent, simple, white.

Type collected by W. A. Murrill under a laurel oak in Gainesville, Fla., June 4, 1938 (No. *F 16476*). Also collected by various persons under hardwoods in and about Gainesville (*F 16428, F 16352, F 16344, F 16277, F 16477, F 16429, F 16353*). This is a shade-loving species, attractive in appearance and excellent for the table. The cup at the base of the stem is quite remarkable and unexpected. In drying, the cup usually becomes finely rimose-striate from the splitting of the cuticle and the disk turns almost black.

Agaricus projectellus sp. nov.

Pileo convexo-plano, 6–8 cm. lato, glabro vel squamuloso; lamellis pallidis, sporis ellipsoideis, 5.5–6 × 3.5–4 μ; stipite 5–8 cm. longo.

Pileus convex to plane, gibbous at times, scattered or gregarious, 6–8 cm. broad; surface dry, smooth, white, sometimes cremeous on the disk, glabrous or with minute, erect, floccose scales; margin projecting 5 mm. at times; context white, unchanging, sweet, edible; lamellae narrow, crowded, pallid for some time before turning pink, finally purplish-brown; spores ellipsoid, smooth, purplish-brown, uniguttulate, 5.5–6 × 3.5–4 μ; stipe smooth, white, subglabrous, subequal, 5–8 × 0.8–1.5 cm.; annulus white, median, ample.

Type collected by E. West, L. Arnold and W. A. Murrill in a pasture south of Gainesville, Fla., June 3, 1938 (No. *F 16219*). Also collected here several times by the author (*F 16431, F 16507, F 16355, F 16299, F 16430, F 16506*) on lawns and in pastures, where it is mistaken by mycophagists for *Agaricus campester*. The young gills, however, are whiter; the margin more projecting; and the spores considerably shorter than in the common meadow mushroom.

Agaricus subplacomyces badius var. nov.

Pileo convexo-expanso, 6–12 cm. lato, albo, badio-squamuloso; sporis 5–6 × 3–3.5 μ; stipite albo, bulboso, 5–10 × 0.8–2 cm.; annulo albo, amplo, persistente.

Pileus convex to expanded, not umbonate, gregarious, 6–12 cm. broad; surface dry, white, conspicuously squamulose, the scales

and disk bay; margin entire, even; context rather thick, white, unchanging, fragrant, nutty; lamellae free but not remote, rounded behind, medium broad, rather close, entire, white when young; spores ellipsoid, smooth, uniguttulate, purplish-brown, 5–6 × 3–3.5 μ; stipe tapering upward from an ovoid bulb, glabrous above the annulus, floccose below, smooth, white, stuffed to hollow, 5–10 × 0.8–2 cm.; annulus superior, membranous, white, persistent.

Type collected by W. A. Murrill under a live-oak in Gainesville, Fla., June 7, 1938 (*F 16402*). A common species here and collected several times about Gainesville in quantity for food, being of excellent flavor even in the raw state. It differs from *A. placomyces* in its shorter, thicker stem, bay disk and scales, and fragrant odor.

NEW COMBINATIONS

For those using Saccardo's nomenclature the following new combinations are made:

DROSOPHILA FLORIDANA = **Hypholoma floridanum**
GALERULA CAESPITOSA = **Galera caespitosa**
GALERULA FLORIDANA = **Galera floridana**
GYMNOPUS SUBAGRICOLA = **Collybia subagricola**
GYMNOPUS TRICHOLOMA = **Collybia Tricholoma**
HYDROCYBE FOLIIRUBENS = **Hygrophorus foliirubens**
OMPHALINA FLORIDANA = **Omphalia floridana**
VENENARIUS ALLIACEUS = **Amanita alliacea**
VENENARIUS FRATERNUS = **Amanita fraterna**
VENENARIUS PRAELONGISPORUS = **Amanita praelongispora**
VENENARIUS SOLITARIIFORMIS = **Amanita solitariiformis**
VENENARIUS SUBALLIACEUS = **Amanita suballiacea**
VENENARIUS SUBSOLITARIUS = **Amanita subsolitaria**
VENENARIUS VIROSIFORMIS = **Amanita virosiformis**

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NOTES AND BRIEF ARTICLES

Water Moulds as a Source of Infection by Pathogenic Species of Phytophthora

In a paper entitled: "The Invalidity of Pythiomorpha" (Trans. Brit. Myc. Soc. vol. XXV, where the argument can be read in full), the authors demonstrate beyond doubt that the reported occurrences of *Pythiomorpha spp.* are in reality records of species of *Phytophthora* (or, rarely, of *Pythium*) found growing saprophytically in water. Until recently *Phytophthora* has not been known as a genus including water moulds, the reason no doubt being that when grown in water, species of *Phytophthora* tend to produce the proliferating sporangium, a feature claimed as the diagnostic characteristic of "*Pythiomorpha.*" It now appears that just as parasitic species of *Phytophthora* can lead a saprophytic existence in the soil, so they may abide saprophytically in water.

The authors are now collecting strains of "*Pythiomorpha*" from all available sources and endeavouring to isolate and identify them, expecting them, for the most part, to be readily assigned to known species of *Phytophthora.* They would recommend that collectors of water moulds all over the world should proceed with caution in the naming of water moulds with a "*Pythiomorpha*" habit, and report any disease-causing species of *Phytophthora* they may isolate from water. They would be interested to hear of any such isolations.—E. M. Blackwell and G. M. Waterhouse

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Is Shiitake a Cortinellus?

The taxonomic position of one of the most important edible fungi of the world, the East Asiatic Shiitake (jap. shii, pronounce: she-e = Pasania; take = mushroom) was quite obscure when I had the opportunity of observing fresh material on my travel through Japan.

Some authors did not even distinguish the Shiitake from the Matsu-take (jap. matsu = pine; take = mushroom), the Matsu-

take being a species of *Tricholoma,* a form of the *T. caligatum*—group, and, as I believe now, perhaps identical with it.

The real Shiitake were sold in January and February on the markets of Kobe, Osaka, Kyoto and Tokyo in fresh and also in dried conditions. It is in cultivation in Japan and gives fruit bodies in all seasons. It has nothing in common with a *Tricholoma.* I bought some characteristic specimens and dried them after macroscopical analysis. The dried material reminded me of some dried exsiccata of *Cortinellus Shiitake,* I had examined in European herbaria. Some years ago I stated that Shiitake from our collections belongs to the genus *Lentinus* but I was afraid that there might have been some mistake in the determination of the specimens examined by me. The anatomic analyses I made in The New York Botanical Garden confirmed my opinion that the *Cortinellus* of the European collections and the Shiitake from the Japanese markets are one and the same species.

Why cannot this species be a *Cortinellus?* The answer is:

Cortinellus in the original idea of Roze chiefly corresponds to a group of veiled *Tricholoma.* In the modern conception, adopted in my system of the Agaricales,[1] *Cortinellus* is restricted to *Cortinellus bulbiger,* an isolated species which, according to my special studies, has not only a *Cortinarius*-like appearance and spore form but also yellowish spore powder and thick spore walls. Shiitake has non bulbus (in general nothing like a *Cortinarius*) ellipsoid-cylindrical spores with very thin membranes. The color of the spores is pure white.

Therefore, there is no doubt that Shiitake is not a *Cortinellus* in the sense of *Cortinellus bulbiger.* But, perhaps, it is a "*Cortinellus*" of the *Tricholoma vaccinum*-type?

Tricholoma vaccinum and allied species have short spores, no thick walled hyphae, no clamp-connections, and they never grow on wood. Shiitake grows on wood of deciduous trees. Its hyphae are principally thick-walled and always have clamp-connections; its spores are almost cylindrical. Also the character of the surface hyphae of the pileus is quite different.[2]

[1] Singer, R. Das System der Agaricales. Ann. Myc. **34**: 286. 1936.

[2] I have to express my gratitude to Dr. Seaver, who was kind enough to allow me the privilege of studying my Japanese material in the herbarium

The only genus with which Shiitake shows an evident affinity is *Lentinus*. The following description, made from our Japanese specimens cannot fail to convince one that all diagnostic characters of this mushroom indicate *Lentinus:*

Lentinus edodes (Berk. non Schröt.) Singer, comb. nov.

Pileus light-brown or dark-brown with a somewhat reddish-brown tinge, scales and center dark, more pale-brown in young specimens at the margin; dry, with innate, triangular or areolate, small or large scales, often fissured in areas or with large white longitudinal fissures, with a colorless to pale-brownish cortina on and near the very acute margin of young fruit bodies, then glabrous and only sometimes with a narrow tomentose marginal zone, convex, later depressed around the convex center, sometimes plane or slightly depressed at last, often really umbonate, 50–110 mm (4–20 cm sec, Imai).—No true epicutis; hyphae of the scales filamentous, interwoven.

Lamellae pale-whitish, later often with reddish-brown spots, especially, where handled, finally with an extremely faint grayish incarnate or brownish tinge; adnate or adnexed-sinuate, but generally soon separating from the stipe and seeming free, crowded or very crowded, up to 4 mm broad the largest point being near the stipe, wavy-denticulate, not ventricose or ventricose near the stipe. —Spore powder pure white.—Spores cylindric-ellipsoid, thin walled, 5.8–6.4 × 2.8–3.3 μ, non amyloid, smooth. Basidia with 4 sterigmas, 30–31.5 × 5.8 μ. Trama regular. Hyphae of the trama hyaline, not amyloid, 5–6 μ in diameter, many of them thick-walled (until 1.6 μ).

Stipe light reddish-brown, whitish-brown, with a ring like cortina downward with darker-brown scales, mostly smooth from the cortina up, often with rib like continuation of the lamellae, solid, hard and subcoriaceous, the thickest part generally in the middle, rarely bulbous at the base, more often compressed, but sometimes central and round (the form of the stipe depends from the position of the substratum, as Sh. Imai states), 30–40 × 8–13 mm, rarely larger.

Context white, brownish under the surface of the pileus, fleshy to tough. Taste slightly acid, not unpleasant. Smell very slight. Hyphae with clamp-connections and many of them thickwalled.

Said to occur only on deciduous trees (Pasania, beech and others). January–December. Eastern Asia.—ROLF SINGER.

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of the New York Botanical Garden. The original exsiccata are deposited in the same Herbarium.